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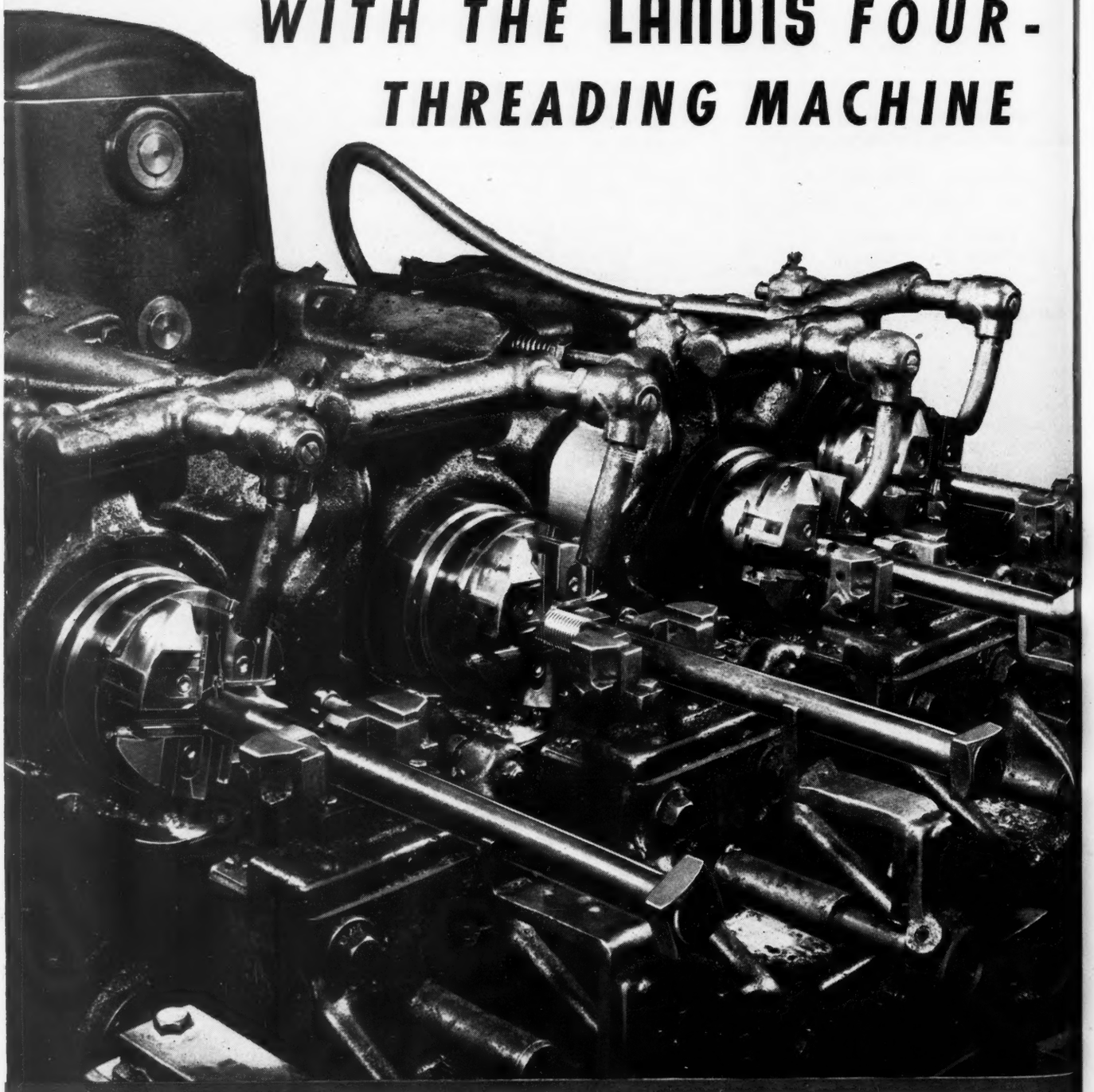
One Machine Bolt Threaded

WITH THE LANDIS FOUR-THREADING MACHINE



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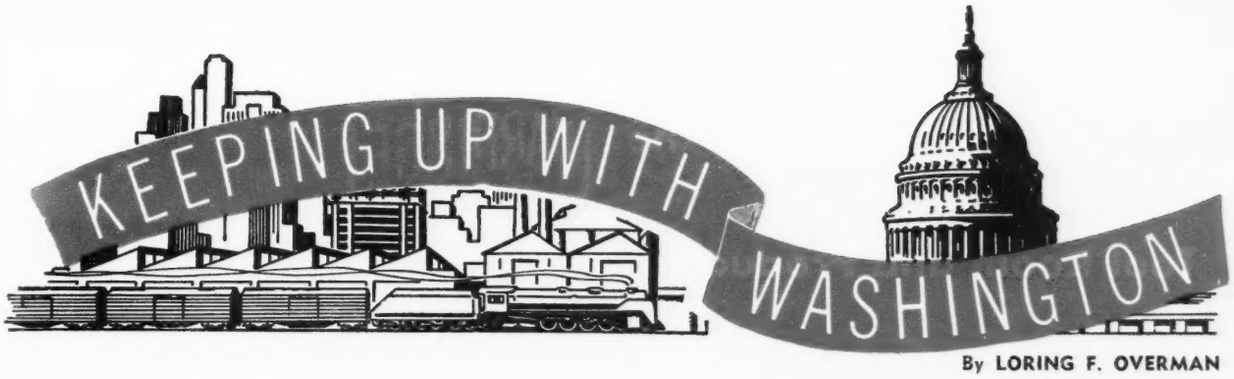

By LORING F. OVERMAN

Cancellation and Placement of Big Defense Orders

THE Air Force recently announced its decision to stretch out the military aircraft program, in order to get as many planes as possible out of funds provided in the fiscal 1953 budget and expend less money than was contemplated for facilities expansion. One idea expressed was that manufacturing improvements may make it possible for industry to produce the needed planes in future years with fewer plants and machine tools.

One of the first victims of the Air Force stretch-out program was the contract to build 757 Bullard 42-inch turret lathes at a cost of some $90,000 each, which had been placed with the Fisher Body Division of General Motors. This cancellation came after the expenditure of around $11,000,000 for manufacturing facilities since last September, when the go-ahead was given. Production was to have started this month.

SOME idea of what the Air Force has in mind with regard to future tooling may be read into its order for two aluminum forging presses—one of 35,000 tons capacity, and the other of 25,000 tons. The two presses are part of a $210,000,000 program to build eight forging and ten extrusion presses. In addition, a plan is now afoot to build a press of 75,000 tons capacity. The largest press up to the present time is a 30,000-ton machine built by the Germans during World War II and later dismantled and shipped to Russia. Such presses are capable of turning out complete structural parts for airplanes with substantial reductions in manpower and machine time.

The two presses contracted for are to be built by Kaiser Aluminum & Chemicals Co., at Newark, Ohio. It is expected that these two machines will turn out 3,000,000 pounds of forgings a month.

THE contract placed by the General Services Administration with Cincinnati Milling & Grinding Machines, Inc., is said to be the largest of its kind in history. This contract calls for the production of 9576 machine tools of all types, to cost $165,361,020. It brings to more than a billion dollars the total value of machine tool orders placed by General Services Administration since the program got under way last spring.

Up to the first of this year, GSA had offered 127 pool orders involving 74,294 machines valued at $1,164,986,583. Manufacturers had accepted 79 orders valued at $855,073,127. Indicative of the bigness of the program is the fact that the total value of machine tools placed in the United States in 1949 was $249,500,000.

FURTHER evidence that tomorrow's methods may solve today's production problems faster and more economically was presented at a meeting in Washington by top officials of the General Electric Co. Unveiling a new method of producing stator blades for jet engines, company officials predicted savings of 55 per cent in cost and 39 per cent in critical materials. The new method, involving fabrication in place of a forging technique previously used, is expected to smash a bottleneck in the turbo-jet engine production program.

In displaying the new blade, more than 1000 of which will be used on the stator of each turbo-jet engine, G-E officials announced plans for a new $30,000,000 jet research laboratory at Lockland, Ohio. Officials also "referred with pride" to the 100 per cent sub-contracting operation at Lockland, where turbo-jet parts made by 17,000 sub-contractors, are assembled into finished engines.

THE Defense Department has found that it must again whip up the horses in forcing delivery of some items. So it has announced a new system of relative urgencies, based on a secret list prepared by the Joint Chiefs of Staff. The most urgent orders are now to be identified by the letter "S," and delivery is to be expedited by a directive. Machine tool builders in the "Z-2" category rate with Army, Navy, and Air Force as entitled to use the new "S" symbol.

"Big Brass" explains that the new system is a simple attempt to obtain what is needed first at the earliest possible time, avoiding the charge made so frequently that the military piles up mountains of easy-to-get items at the expense of hard-to-get items which must be obtained, regardless of whether a war is to be fought or peace maintained.

NEW techniques that will aid the metallurgical industries to produce better high-temperature alloys, more durable turbine blades, and better steels are covered in the January issue of the Office of Technical Services' publication, "Bibliography of Technical Reports." Copies are available at 50 cents each from the U. S. Department of Commerce, Washington 25, D. C.

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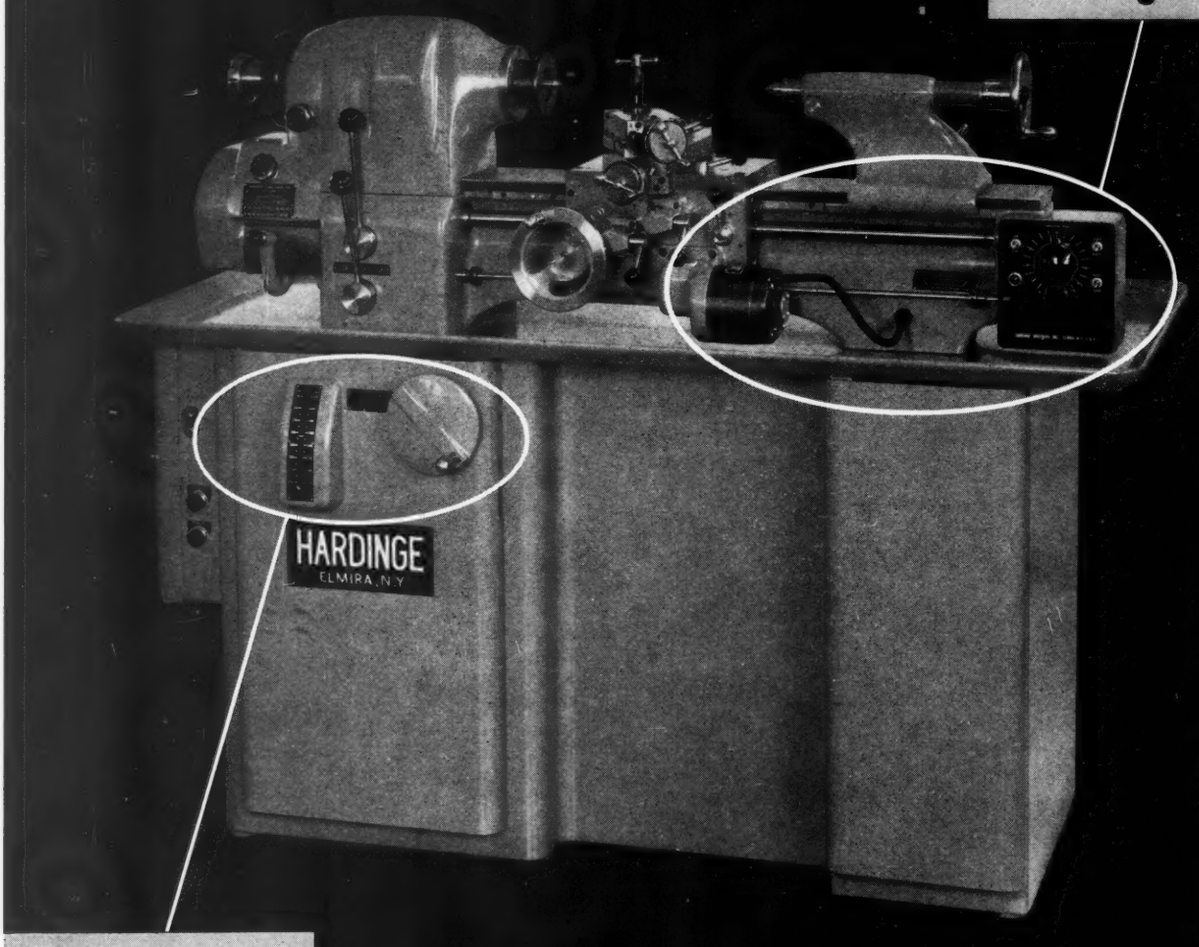

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Modern Magic!

DURING the medieval days of Europe, alchemists and astrologers mystified the populace with their purported transmutation of the baser metals into gold or silver and their prognostications of fortunate or direful events to come.

But even if the claims of these oldtime wizards and magicians had been substantiated, their achievements would hardly have seemed more miraculous than some of the daily practices in our industrial plants today. Who would have dreamed a year or two ago, for example, that sound waves would be employed to facilitate the removal of grease and grime from metal parts? This is being done today by a manufacturer of safety razors.

Ultra high-frequency sound waves agitate the washing solution to provide faster and more efficient cleansing of the work-pieces, and at a cost reduction that runs as high as 58 per cent over previous methods. Imagine — sound can cause chemical and physical reactions of practical value to industry. Embedded dirt disappears as though by magic.

The utilization of light waves for checking the accuracy of flat surfaces within a millionth part of an inch is not a new practice, but to the uninitiated it borders on the fantastic. Light waves are commonly applied to check the gage-blocks on which our industrial inspection systems are based.

The use of X-rays for detecting internal flaws in castings and welded structures has been everyday practice for some years, and now fluoroscopy is being applied for the same purpose. With the fluoroscope, the internal condition of metal parts can be determined immediately, without waiting for photographic films to be developed.

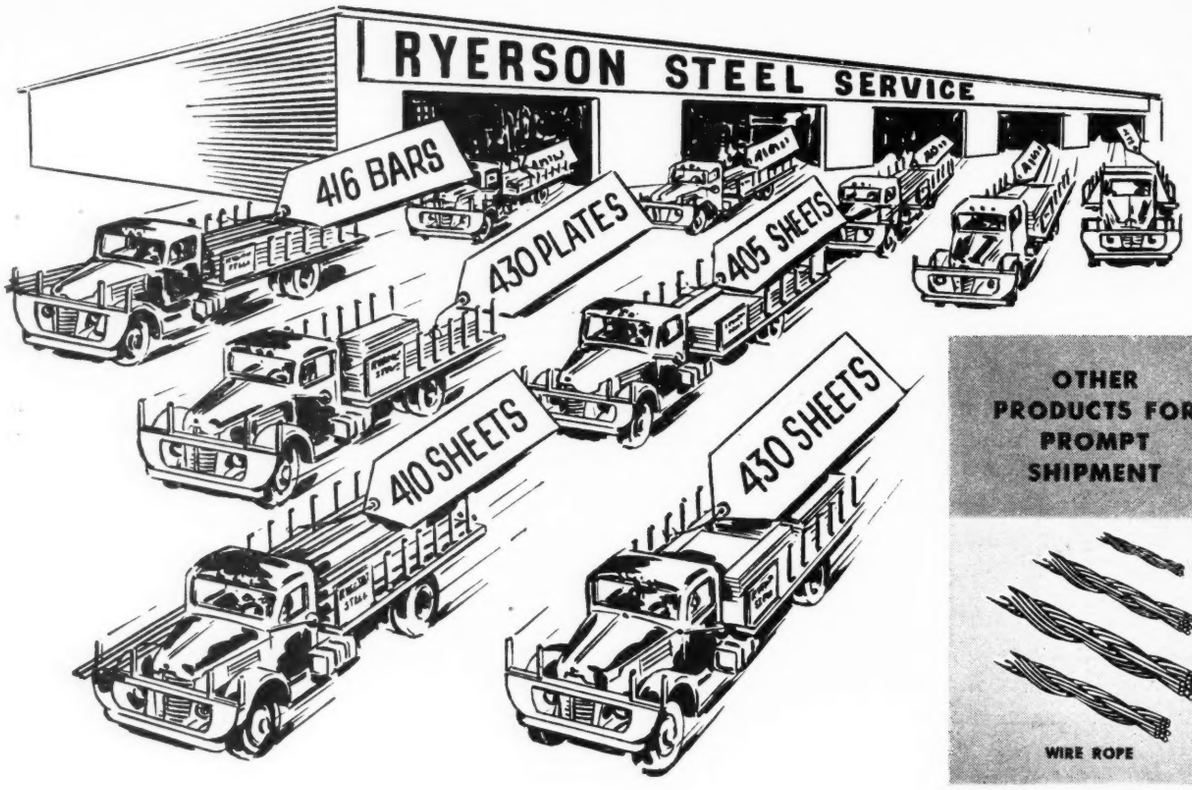
Another recent spectacular achievement is a process by which metal is removed with electric sparks from hardened steels, carbides, and "super alloys" whose application has been limited because of machining difficulties. In this new process, the action is a mechanical rather than a thermal one. Internal mechanical stresses are set up by means of electric current of extremely high density, which causes the metal particles to be detached from the work without being melted. Only an infinitesimal amount of stock must be subsequently lapped from the resulting surfaces in order to obtain a high finish. The original physical characteristics of the metals are unchanged.

Atomic energy is now entering the industrial picture! A device has recently been developed that measures the thickness of metals, plastics, paper, and other products to an accuracy hitherto unobtainable.

Even ordinary shop practices of this day and age would have been beyond the comprehension of the ancient wise men!

Charles O. Herb

EDITOR



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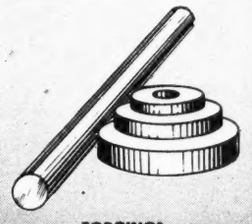

FORGINGS

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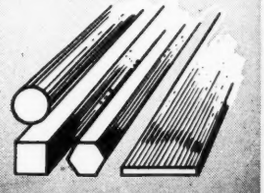

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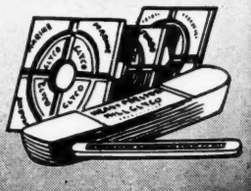
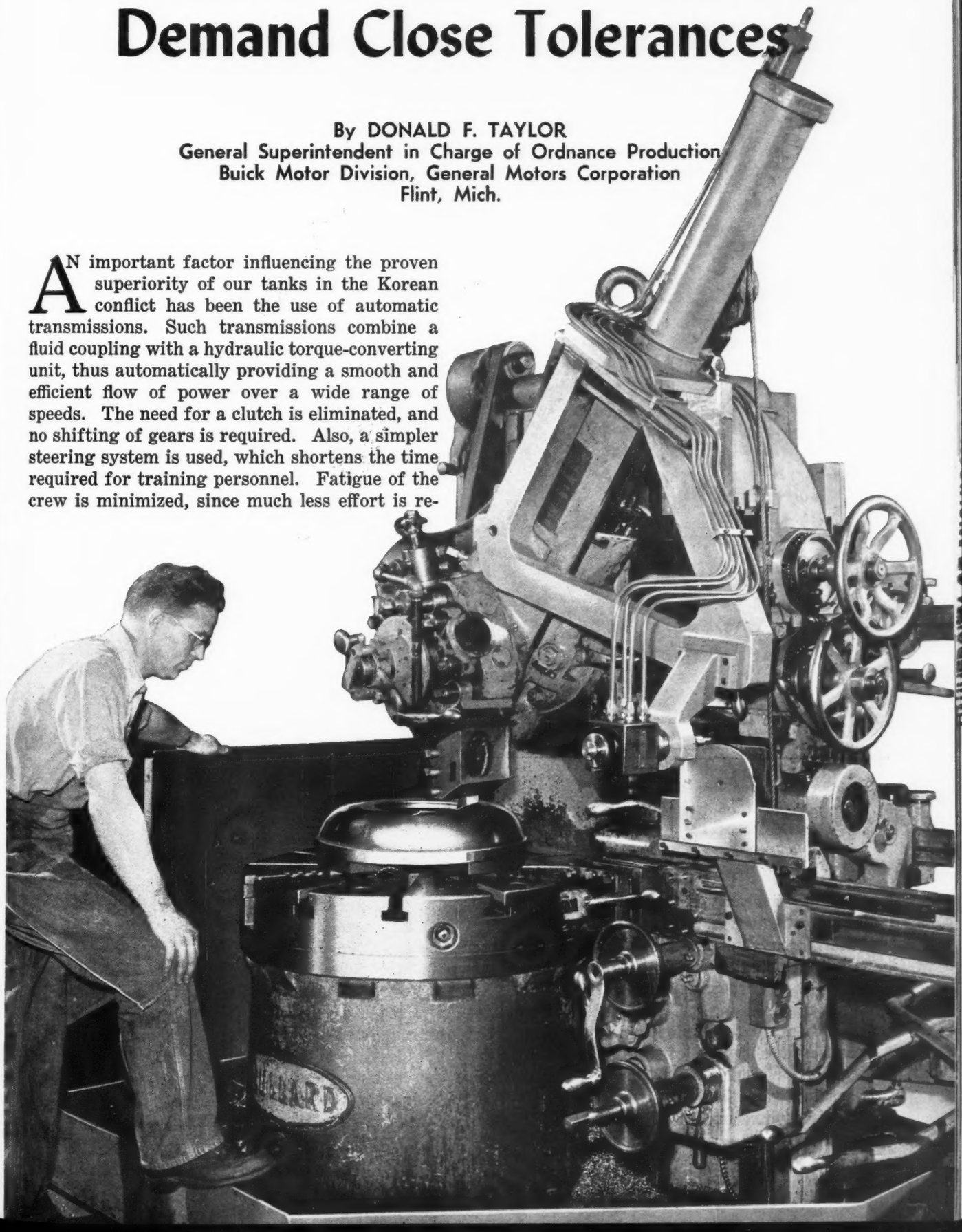


BABBITT METAL

Automatic Tank Transmissions Demand Close Tolerances

By DONALD F. TAYLOR
General Superintendent in Charge of Ordnance Production
Buick Motor Division, General Motors Corporation
Flint, Mich.

AN important factor influencing the proven superiority of our tanks in the Korean conflict has been the use of automatic transmissions. Such transmissions combine a fluid coupling with a hydraulic torque-converting unit, thus automatically providing a smooth and efficient flow of power over a wide range of speeds. The need for a clutch is eliminated, and no shifting of gears is required. Also, a simpler steering system is used, which shortens the time required for training personnel. Fatigue of the crew is minimized, since much less effort is re-



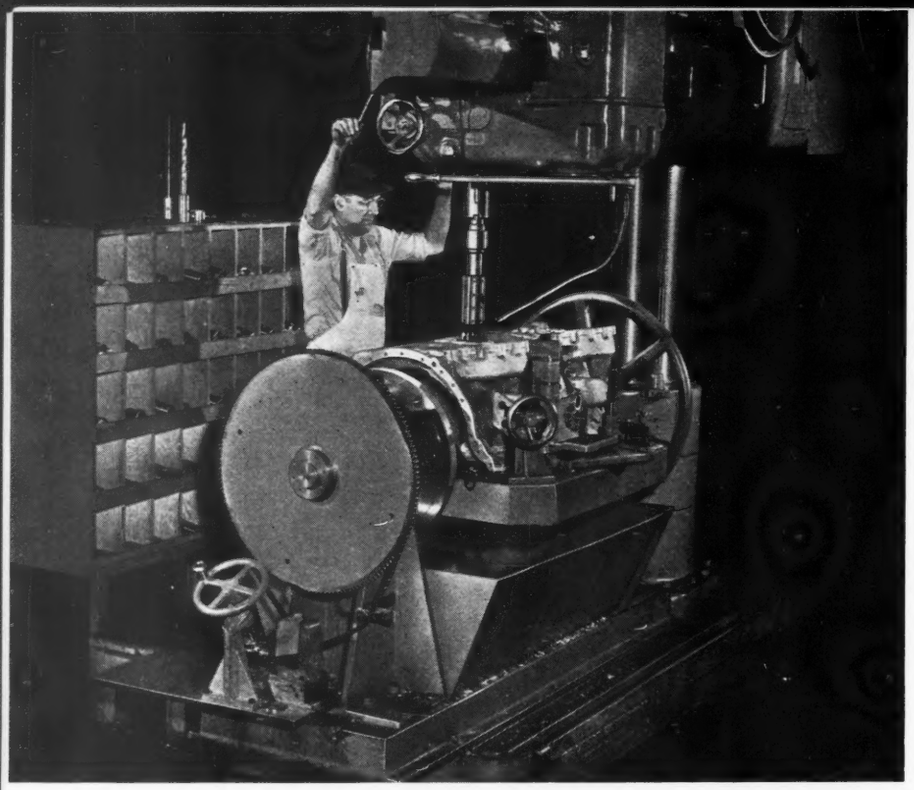


Fig. 1. Forty-one drilling, counterboring, reaming, tapping, and spot-facing operations are performed on nineteen holes in the cast housing on this radial drilling machine

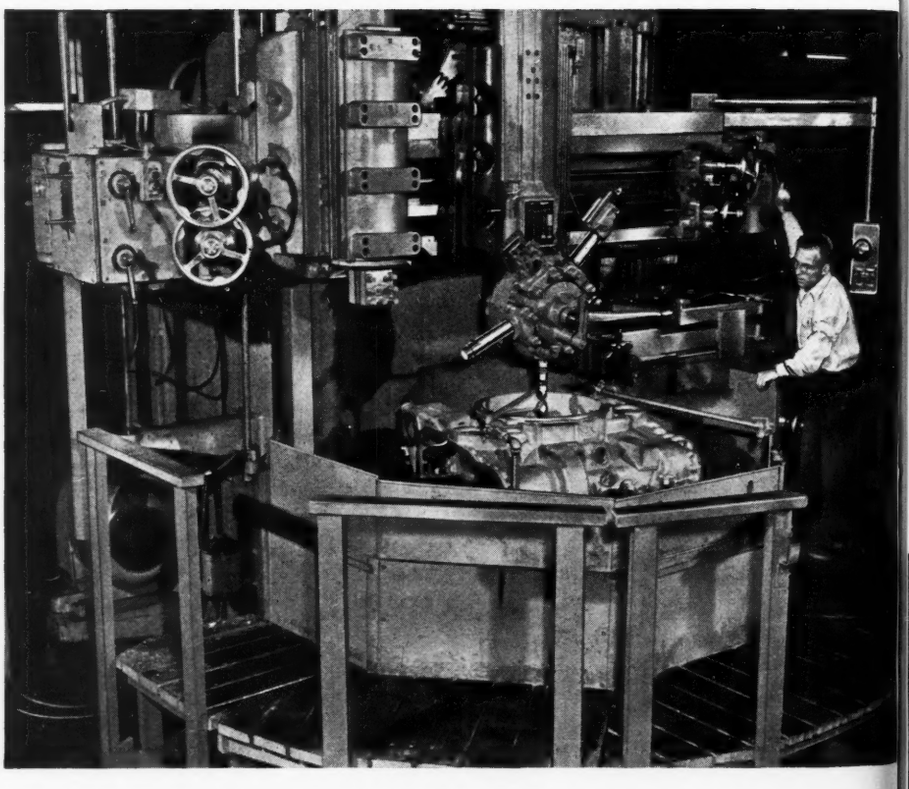


Fig. 2. Cast-aluminum front housings for the automatic tank transmission are drilled, bored, faced, and turned on a vertical turret lathe as illustrated here

quired to steer a tank equipped with an automatic transmission.

Within eight months from the date of contract with the Government, the Buick Division of General Motors Corporation produced its first automatic transmission. Considerable improvising was necessary to attain production so quickly, because of shortage of the required machine tools. Now, nearly 900,000 square feet of floor space in twelve buildings within Buick's Flint plant is devoted exclusively to the production of this transmission, which is the same as the one manufactured by the Allison Division of General Motors Corporation.

Since parts of the transmission operate at pressures exceeding 225 pounds per square inch, and at temperatures higher than 270 degrees F., extremely close tolerances are required to prevent leakage of the hydraulic fluid. Some of the outstanding operations performed in manufacturing the automatic tank transmission will be described in this article.

Front and rear housings, which form the outer shell of the transmission, are sand cast from an aluminum alloy conforming to Aeronautical Material Specification 4214. This material is similar to SAE 322 (Type 2 alloy), and has a nominal composition of 5 per cent silicon, 1.2 per cent copper, 0.5 per cent magnesium, and the remainder aluminum. Each casting weighs approximately 250 pounds, and measures about 40 inches square by 12 inches high.

Rear housings are drilled on the Carlton radial drilling machine seen in Fig. 1. The drilling machine, which has a 6-foot long arm and a 19-inch diameter column, is equipped with a trunnion type fixture to facilitate positioning the work. Forty-one operations—including drilling, counterboring, reaming, tapping, and spot-facing—are performed on nineteen different holes in this one set-up. The holes vary from 1/4 inch to 3 5/16 inches in diameter, and several must be held within ± 0.0005 inch of the required size. The cast housing is rotated to three different positions to complete the operations.

Tools and gages to be used on successive holes are identified by painting consecutive numbers on them, and they are kept in individual, numbered compartments in a tool bin behind the operator. Sheffield Precisionaire air gages are provided on a bench beside the machine to inspect the close-tolerance holes. The tools are rotated at an average surface speed of 200 feet per minute, and fed at 0.008 inch per revolution.

The front housings for the transmission are drilled, bored, counterbored, faced, and turned on the Bullard 64-inch vertical turret lathe seen in Fig. 2. The vertical turret-head is equipped with tools for drilling, boring, and counterboring the center bearing hole. The right-hand side-head holds four single-point, carbide-tipped tools for rough- and finish-facing the flange to which the engine is bolted, and rough- and finish-turning the engine mounting pilot. The location of this 21 5/8-inch diameter pilot must be maintained within ± 0.001 inch, and its diameter is held to ± 0.0015 inch. Up to 1/2 inch of stock is removed in the roughing cuts, and about 0.030 inch in finishing. The cast housing is rotated at 100 R.P.M., while the tools are fed at the rate of 0.010 inch per revolution.

Torque converter turbines for the automatic tank transmission are thin-walled, aluminum-alloy castings with integral vanes. A plaster-mold technique is employed to cast the turbines to close tolerances. The turbines are made from an aluminum alloy containing 5 per cent silicon, 1.2 per cent copper, and 0.50 per cent magnesium, and are solution heat-treated and aged to attain a Brinell hardness of 70.

Since the torque converter turbines are cast to very close tolerances, little machining is required on these parts. However, it is necessary to balance the castings within 1 ounce-inch, and to maintain the wall thickness after balancing at not less than 3/16 inch. The turbines, which have a diameter of about 18 5/8 inches, are balanced on the General Motors balancing machine seen at the left in Fig. 3.

After noting the amount and direction of unbalance, the turbine is transferred to the American 20-inch lathe shown at the right for profile-turning. The casting is located by the previously machined bore and face, and is clamped against the faceplate by means of an air-operated drawbar. It is positioned eccentricallv, according to the magnitude and location of unbalance, by means of a graduated dial on the faceplate. A

Fig. 3. Vaned torque converter turbines are balanced within 1 ounce-inch in the machine seen at the left. The castings are profile-turned on the lathe at the right

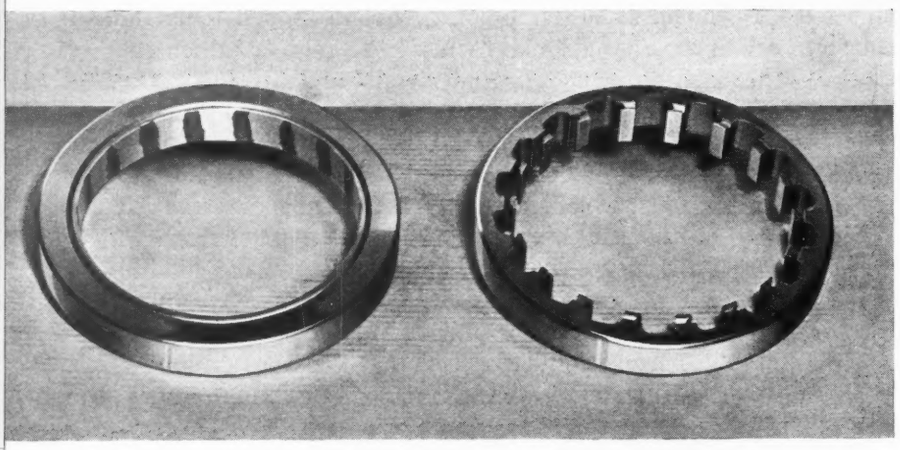


Fig. 4. Stator cam for the over-running clutch of the torque converter before broaching (left) and after broaching (right) in the set-up seen in Fig. 5

single-point cutting tool, mounted in a special holder on the cross-slide of the lathe, is pivoted about the rotating work on a 2.670-inch radius. Approximately 3/32 inch of stock is removed from the heavy sections of the casting. After being profile-turned, the part is again returned to the unbalance measuring machine to insure that the balance is within the required limits.

An important part of the automatic transmission is the over-running clutch for the first and second stator of the torque converter. This cam and roller type clutch permits the stators to rotate in one direction, but prevents them from rotating in the opposite direction. Two stages in the manufacture of the first and second stator cam for this clutch are illustrated in Fig. 4. First the cam, which is forged from S A E 8655 steel, is turned, bored, and faced. Then bronze is arc-welded to eighteen equally spaced spots (1/2 by 1 by 1/16 inch thick) in the bore. After finish-facing both sides, semi-finishing the bore, and grinding the periphery, the cam appears as shown at the left.

Eighteen equally spaced cam lobes are then formed in the bore by rough- and finish-broaching, as seen at the right. These operations are performed on American 10-ton, vertical pull type broaching machines. The work-piece is held in a pot chuck, being located from its periphery (which has been previously ground within ± 0.0005 inch) and against one face, and aligned radially so that the broaches will cut between the bronze welds.

In rough-broaching, Fig. 5, two broaches are employed, and the part is indexed nine times to complete the eighteen cam lobes. In finish-broaching, the contour at the bottom of the cam slots is formed, and the groove or under-cut on one side of each slot is cut. This necessitates eighteen indexings of the work. More than 1/2 inch of stock is removed from each cam slot in rough-broaching.

An unusually difficult operation is that of selectively hardening the eighteen internal lobes of the clutch cam. However, uniform hardness is obtained at high production rates with practically no scrap and negligible distortion by the use of a Cincinnati "Flamatic" machine, set up as seen in Fig. 6. With this equipment, all eighteen of the internal lobes are hardened simultaneously in a heating cycle of thirty to thirty-five seconds. A uniform hardness pattern is obtained, and the areas, approximately 3/16 inch deep by 7/16 inch wide, at the bottoms of the cam slots have a hardness of from 58 to 60 Rockwell C.

On the "Flamatic" machine, a single combination work-spindle and flame-head consisting of a brass burner containing eighteen rows of six ports is employed for selectively heating the discontinuous surfaces simultaneously. When an over-running clutch cam has been pressed on the work-spindle, oxy-propane gas passing through the ports is ignited by means of retractable electrodes. These flames impinge on the internal cam lobes to be hardened and rapidly heat them to a pre-set temperature.

Accurate temperature control—within $\pm$ 5 degrees F.—is obtained by means of a sensitive thermopile (top center) which is focussed to receive radiant energy from the work (in this case, from the periphery of the cam). The amount of radiation is proportional to the temperature of the work surface, and the corresponding voltage generated in the thermopile actuates a temperature recording and controlling instrument calibrated in degrees F.

When the surface reaches the pre-set temperature, the flames are automatically extinguished, the work-spindle retracts, and a stripper plate causes the cam to fall into an oil quench tank. A wire-mesh endless conveyor belt passing along the bottom of this tank carries the hardened part up to the right-hand end of the machine (not shown).

Copper-tube cooling coils through which cold water is circulated prevents the bronze welds in

the bore of the part and the thin sections at the under-cut grooves in the cam slots from becoming overheated. One part by volume of propane, regulated to a pressure of 6 pounds per square inch, is mixed with 6 1/2 parts of oxygen, regulated to a pressure of 28 pounds per square inch, before passing through the gas ports.

After being hardened, the over-running clutch cams are drawn to relieve the stresses, grit-blasted, finish-ground on the periphery and cam lobes, and precision-bored. Then locking splines are hobbed on the periphery of the cam, two at a time, on a Cleveland single-spindle hobbing machine, Fig. 7. The cams are located by the bore and against one face. The 20-degree involute splines have a 16/32 pitch, a chordal tooth thickness at the pitch line of 0.1011 inch, and a diameter (over two 0.108-inch diameter pins) of 8.2856 inches. Each cam has 130 splines or teeth. The bore of the cam must be concentric with the pitch diameter of the splines within 0.003 inch total indicator reading.

A rather difficult operation is the machining of the hub and flange of the cast-steel end cover for the tank transmission. The large irregular-shaped flange, requiring interrupted cuts, must be machined flat and smooth, and its bore (about 21 7/16 inches in diameter) must be held to size within $\pm$ 0.0015 inch. Also, the multiple-diameter central hub must be turned (including taper turning), bored, faced, chamfered, and grooved to close tolerances. All of these operations are performed with one setting of the work on the Bullard vertical turret lathe seen in Fig. 8.

Fifteen carbide-tipped tools are provided on this machine—thirteen on the five heads of the vertical turret and two on the side-head. With three tools held in the No. 1 head on the turret, the hub of the steel casting is rough-turned and chamfered. At the same time, a tool on the side-head rough-faces the large-diameter flange. The No. 2 turret-head also holds three tools which are used to face the top and bottom of the hub and rough-bore the flange. Two tools on the No. 3 head rough-bore and taper-turn the hub.

When these operations have been completed, the work-piece is loosened to relieve any stresses set up during machining, and is then reclamped. One of the tools on the No. 3 head is then used again to finish-turn the tapered surface on the hub periphery.

Two tools on the No. 4 turret-head finish-turn the large-diameter surface on the hub, cut an oil-groove 0.032 inch deep in the hub, and finish-face the hub. Simultaneously, another tool on the side-head finish-faces the large flange. The No. 5 turret-head holds three tools for recessing, finish-facing, chamfering, and finish-boring the flange.

About 1/4 inch of stock is removed from the casting in the roughing cuts, and another 0.023 inch in finishing. The work is rotated at 63 R.P.M. during roughing, while the turret tools are fed at the rate of 0.010 inch and the side-head tools at 0.008 inch per revolution. In finishing, the work rotates at 135 R.P.M. and the tools are fed at 0.005 inch per revolution. For turning the tapered surface on the hub periphery, considerably lower speeds and feeds are required. In this case, the work is rotated at 8 R.P.M., and the tools fed at 0.003 inch per revolution.

A considerable amount of stock is automatically machined from the forged-steel drive flange for the converter output shaft of the automatic transmission by means of the set-up seen in Fig. 9. On this Potter & Johnston automatic turret lathe, the S A E 3140 steel forging, which is approximately 8 3/4 inches in diameter by 6 inches long, is core-drilled, bored, counterbored, taper-bored, turned, and faced in an eleven-minute automatic cycle. For these rough-machining operations, the forging is gripped on its tapered shank by a three-jaw chuck, and rotated at 76 and 93 R.P.M. during different parts of the cycle.

The turret and the front and rear tool-holders are advanced and retracted, and the turret is indexed, all automatically. The different tools,

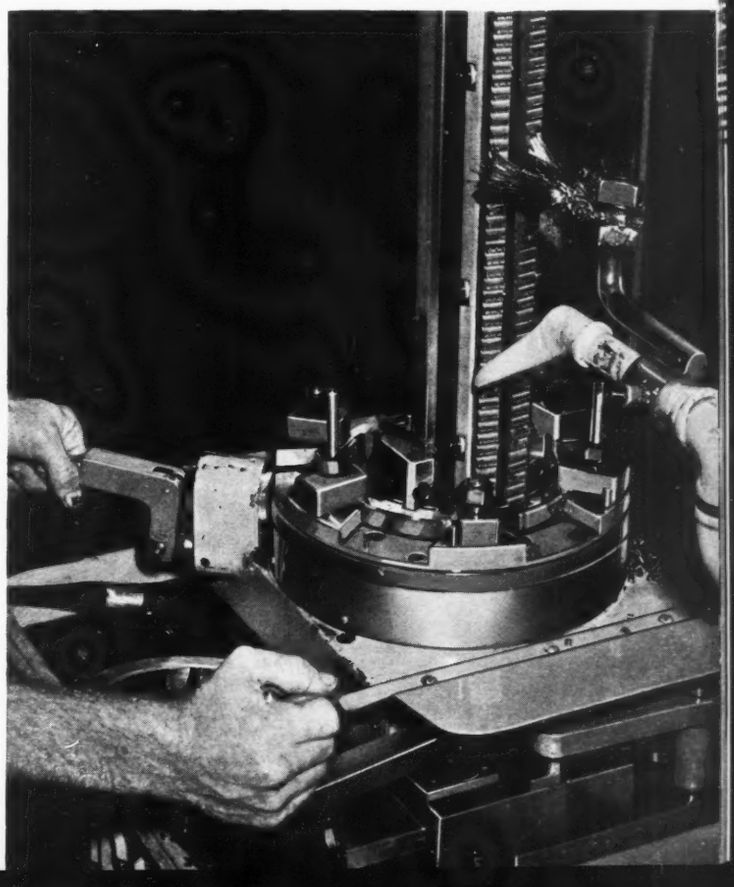


Fig. 5. Internal cam lobes, as seen at right in Fig. 4, are rough-formed on a 10-ton, vertical, pull type broaching machine. Nine indexings are required to complete each part

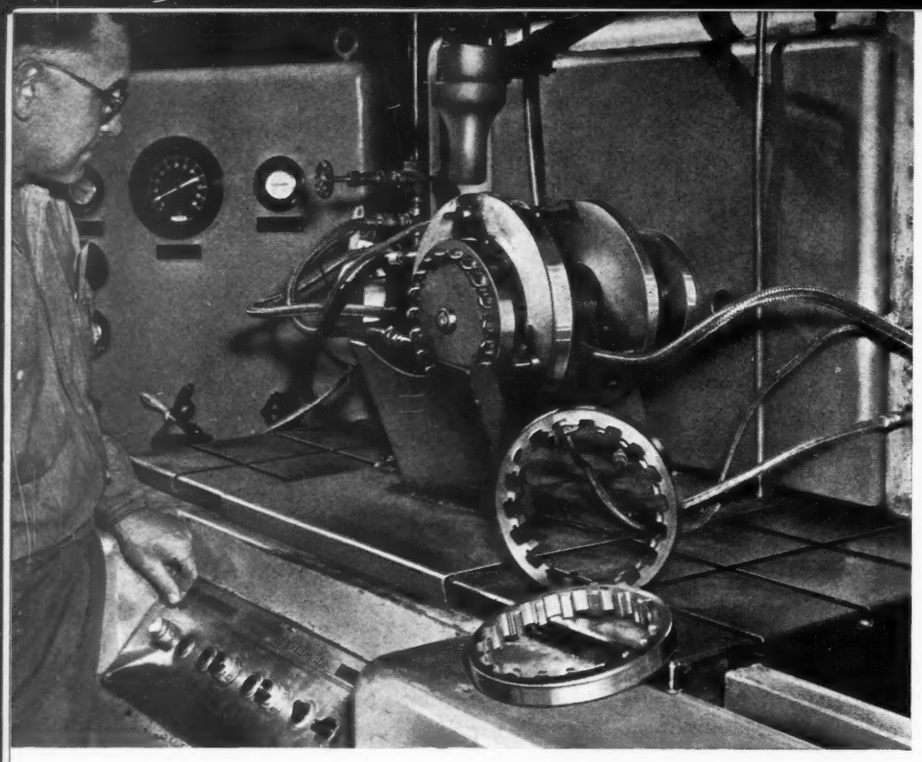


Fig. 6. Eighteen internal lobes of the over-running clutch cam are selectively hardened simultaneously on this flame-hardening machine. Oxy-propane gas is employed

which are all carbide-tipped except the core drill, are fed at rates varying from 0.004 to 0.012 inch per revolution. Up to 5/16 inch of stock is removed from the various surfaces. After the completion of the rough-machining operations, the parts are heat-treated to a hardness of 34 Rockwell C, and then finished on a similar automatic turret lathe.

High-strength covers for the torque converter turbine are forged from S A E 8740 steel. It is necessary to contour-machine the forgings so that they will conform in shape with the turbine. This is accomplished on a Bullard vertical turret lathe equipped with a Turchan automatic tracer-duplicator, as seen in the heading illustration. Movement of the cross-slide and vertical slide of the lathe is controlled by hydraulic cylinders. Oil flows to these cylinders through a valve which is controlled by a tracer in contact with a template. The template, seen at the right, has the same contour as that to be duplicated on the forging.

The turbine cover forgings, which are approximately 20 1/4 inches in diameter, are gripped on their bores by means of a three-jaw chuck mounted on the rotary table of the vertical turret lathe. About 3/4 inch of stock is removed from the contour of the forging in three passes. The tracer tip in contact with the template is changed after each pass, starting with a 7/8-inch diameter tip for the first cut, then substituting a 5/8-inch diameter tip, and finally using a 3/8-inch diameter tip for the last pass.

With the work rotating at 60 R.P.M., the car-

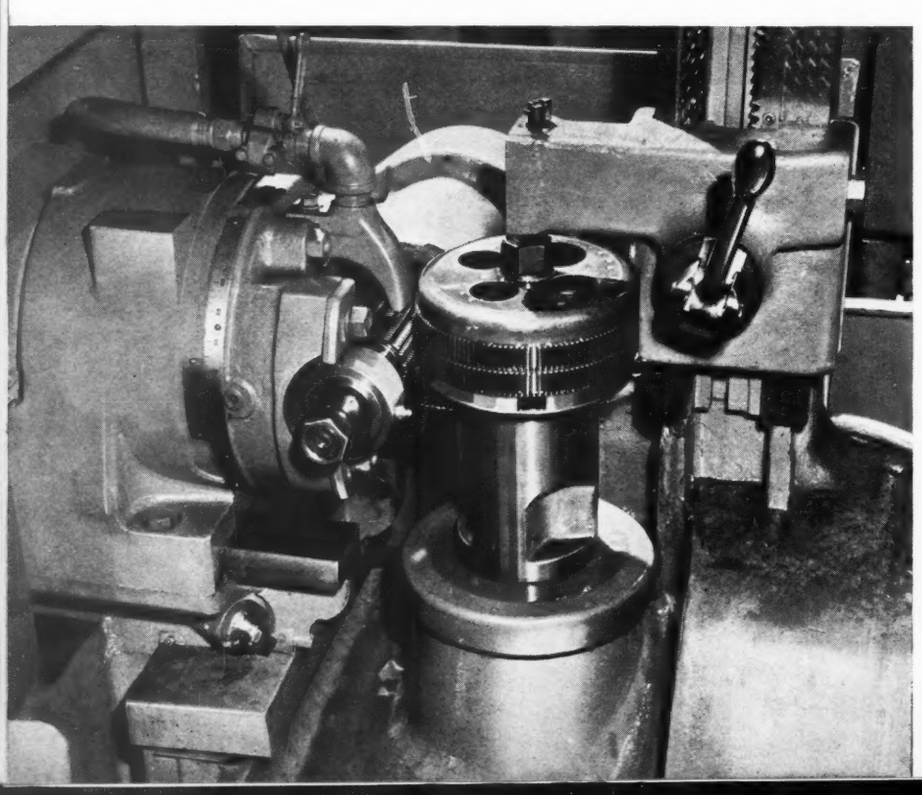


Fig. 7. Splines are cut on two cams at a time in this operation. Each cam has 130 splines of 16/32 pitch with a chordal tooth thickness of 0.1011 inch

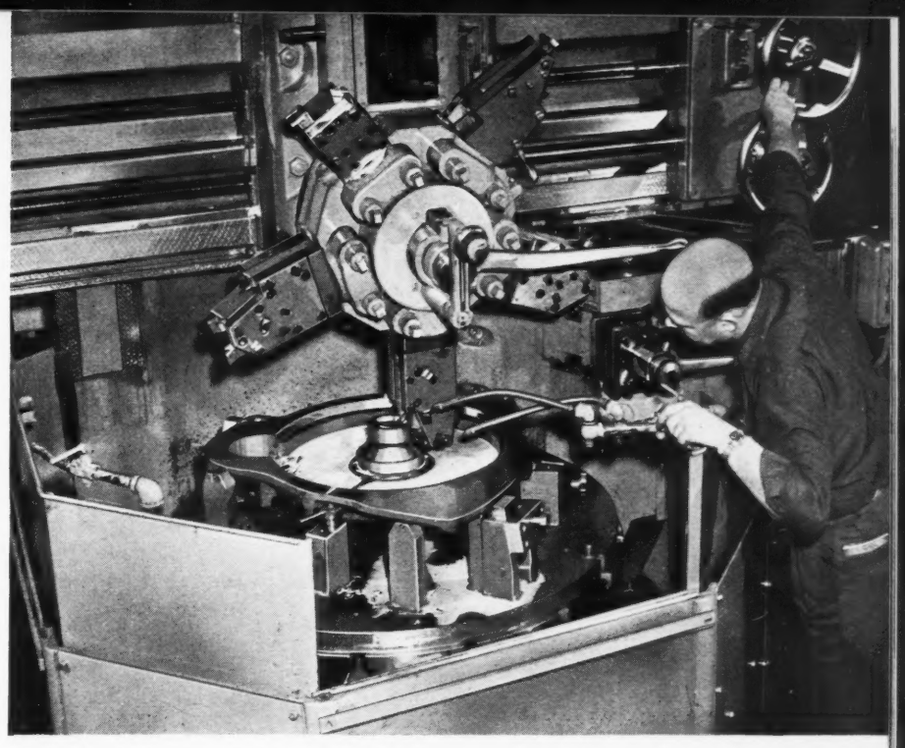


Fig. 8. Fifteen tools are employed on a vertical turret lathe to machine cast-steel end covers. The tolerance on the 21 7/16-inch diameter flange bore is ±0.0015 inch

bide-tipped generating tool is fed at 0.011 inch per revolution. About fifteen minutes is required to complete each part. A series of four such vertical turret lathes is employed, the periphery and bore of the forging being rough-turned on the first two machines and finish-turned on the last two machines. The finished bore is maintained within ± 0.001 inch of the desired size.

The bore and face of forged-steel clutch pistons for the tank transmission are both ground to close tolerances and a smooth finish in one automatic cycle on the Bryant internal grinding machine shown in Fig. 10. After locating the forging against its back face, the periphery is clamped by means of a Woodworth air-operated diaphragm chuck having six jaws.

In the automatic cycle, the grinding wheel, which is 6 inches in diameter by 1 1/2 inches wide, removes about 0.010 inch of stock from the face of the work-piece. Then the work is automatically positioned transversely and advanced axially to remove about 0.008 inch of stock from the bore of the forging. The bore, approximately 10 1/2 inches in diameter, is held to size within ± 0.0015 inch, and at right angles to the face within ± 0.0005 inch. Maximum "roughness" of the surface finish produced in this operation is 40 micro-inches r.m.s. The resinoid-bonded wheel, containing aluminum-oxide abrasive of 46 grain size and M hardness, is rotated at 3600 R.P.M., while the work revolves at 135 R.P.M.

After assembly, the automatic tank transmissions are subjected to a comprehensive ninety-minute operational run on test stands such as

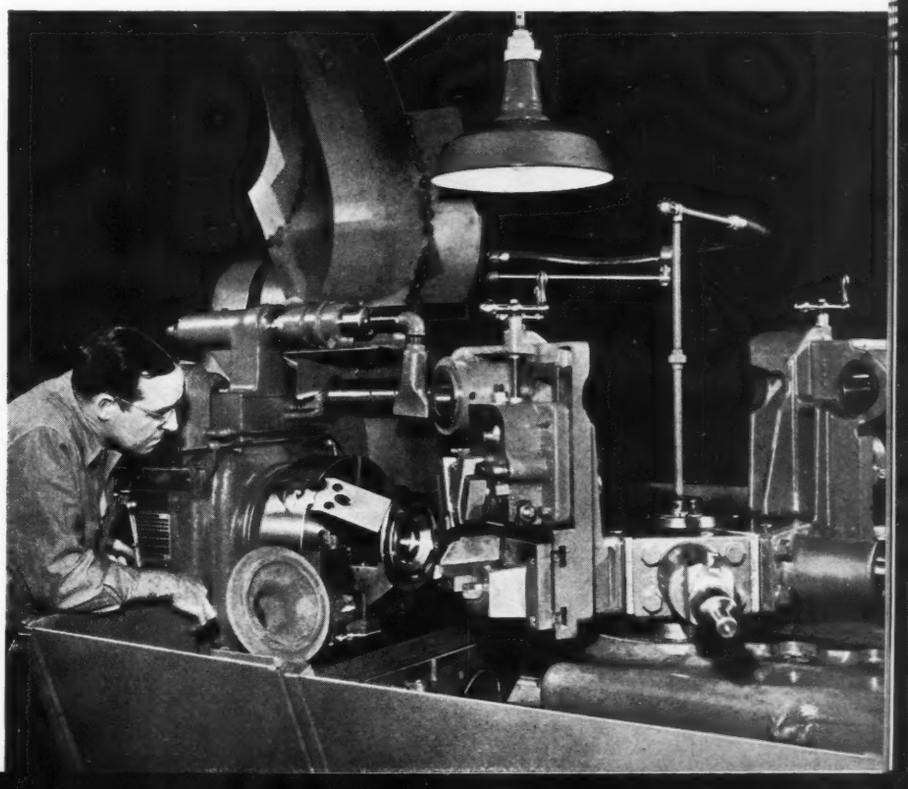


Fig. 9. Forged-steel drive flanges for converter output shafts are drilled, bored, turned, and faced in an eleven-minute cycle on this automatic turret lathe

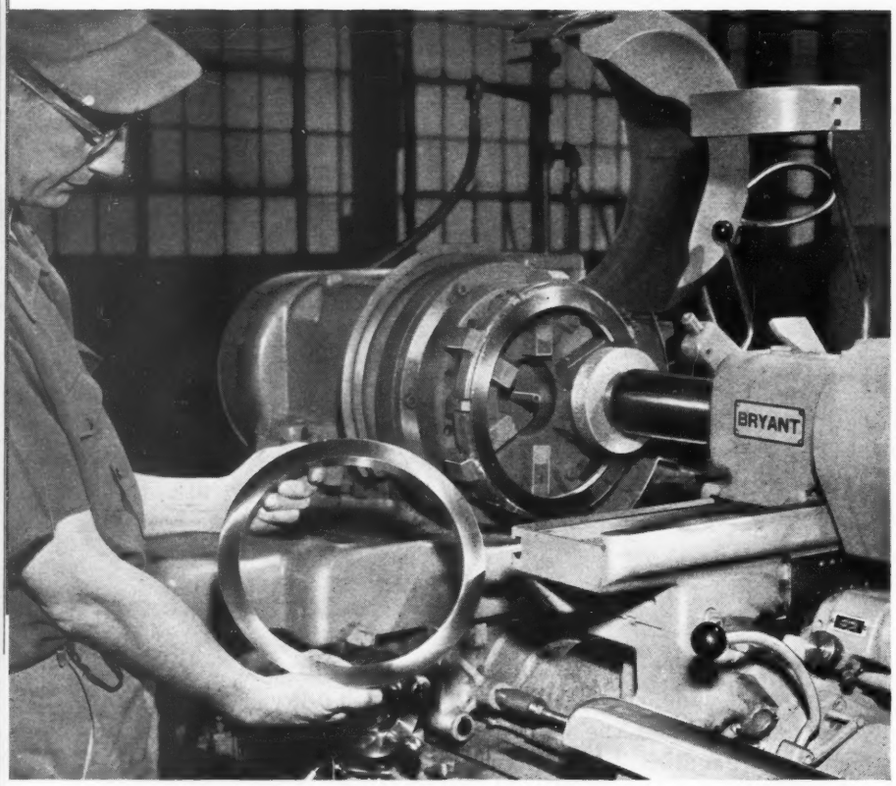


Fig. 10. Internal grinding machine set up to finish the bore and one face of forged-steel clutch pistons in one automatic cycle

the one seen in Fig. 11. Each of the nine test stands has a 500-H.P., alternating-current drive motor with a magnetic clutch which is excited to deliver the required speeds up to 1800 R.P.M. for the various tests. Absorption type dynamometers, equipped with brakes and diaphragm type torque indicators to measure the torque, are connected to the two output flanges of each transmission by floating gear type couplings. A water-cooled heat exchanger maintains the temperature of the 25 gallons of oil in each transmission at about 270 degrees F.

Operational runs include a warm-up test, a service brake test, a steering test, a high-gear test, a low-range test, a high-speed test, and a low-speed check. By means of mercury manometers and calibrated dial indicators mounted on a control board, as seen in the foreground of the illustration, pressures, torque, oil-flow rates, temperatures, speeds, and time of the various tests can be recorded. Approximately every tenth transmission is completely dismantled after testing to permit a thorough physical inspection of all moving parts of the transmission.

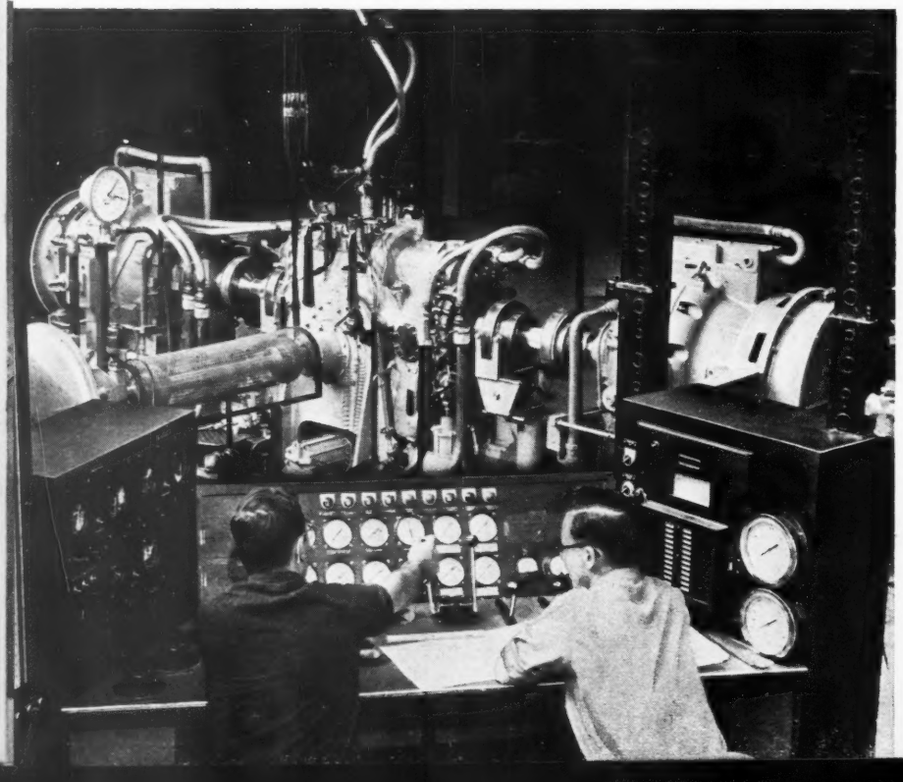


Fig. 11. One of the test stands used to perform a ninety-minute operational run on assembled automatic tank transmissions

Precision Drilling and Boring without Jigs and Fixtures

AMONG the numerous precision machining operations performed at the Daco Machine & Tool Co. in Brooklyn, N. Y., are the boring and facing of cast-aluminum housings for infra-red spectrometers. This work requires a high degree of accuracy, the hole sizes and locations being held to tolerances as close as plus or minus 0.0005 inch.

The necessary accuracy is obtained without the use of jigs and fixtures by employing the DeVlieg "Jigmil" shown in Figs. 1 and 2. Three faces of the rectangular casting shown are machined with this equipment. The first face requires the boring of two holes 1.250 inches in diameter, plus or minus 0.001 inch, the relative location of which must be exact within a tolerance of 0.0005 inch. These holes are counterbored to a diameter of 1.875 inches, 0.130 inch deep, in the same set-up.

When the operations on this face are completed, the indexing table is moved 180 degrees to present the opposite face of the casting to the tool. The set-up for this operation is illustrated in Figs. 1 and 2. With the work in this position, a hole is bored to a diameter of 3.250 inches, plus or minus 0.0005 inch. This hole is located relative to the two holes bored in the first face within plus or minus 0.0005 inch by working from a pin in the flange of the housing.

The table is then indexed 90 degrees for machining the third face. A hole 1.030 inches in diameter is produced in this face within a tolerance of plus or minus 0.001 inch. This hole is located by the pin previously used to maintain the relationship of hole locations within plus or minus 0.0005 inch. The casting is also machined in this position to produce a pad around the hole a distance of 0.650 inch from the outermost edge of the casting. Using carbide tool bits at speeds and feeds recommended for this material, the floor-to-floor time for machining the aluminum housings was 3 1/2 hours.

Another example of precision work performed on a DeVlieg machine may be seen in Figs. 3 and 4. Here the "Jigmil" is being employed to drill and bore gray cast iron (ASTM A48, Class 30) gear-boxes at the Elizabeth, N. J., plant of American Type Founders, Inc. Hole sizes are held to tolerances of plus or minus 0.0003 inch. The floor-to-floor time for this work is approximately seventy-five minutes. Carbide tools are used in performing these operations.

Fig. 1. Hole locations are held within 0.0005 inch and close hole sizes are maintained without the use of jigs in this set-up on a jig boring machine

Fig. 2. Complete electric control of machine permits operator to obtain a high degree of accuracy in boring and facing cast-aluminum housings

One of the most important features of the DeVlieg machine is the electric automatic control, which permits the operator to obtain the required accuracy by merely operating push-buttons. The saddle and spindle heads are positioned by means of location rods in which stop-plugs are inserted to arrest the motion of the slides. Two location rods with stop-plugs to suit the requirements of the work are used, one for the saddle and one for the spindle slide.

The automatic positioning of either the table or the spindle head is controlled by a selector lever and a selector switch. When, for example, the saddle is to be positioned, the lever and switch are moved as required, and the "automatic position" button is pressed. This causes rapid traverse of the saddle until a stop on the location rod contacts the finger of a limit switch and de-energizes the magnetic starter for the rapid-traverse motor, permitting the saddle to over-run by 0.020 to 0.030 inch.

By means of a time delay, pre-set on another relay, the rapid-traverse motor is cut out and the feed motor is energized, reversing the table, which moves to the left until the limit switch is operated again, when the feed motor is stopped. The table at this stage has over-run by 0.005 to 0.010 inch. The feed motor is then reversed at

Fig. 3. Using a "Jigmil" to drill and bore cast-iron gear-boxes to close tolerances. Carbide tools are used for these operations, and the time required is about seventy-five minutes

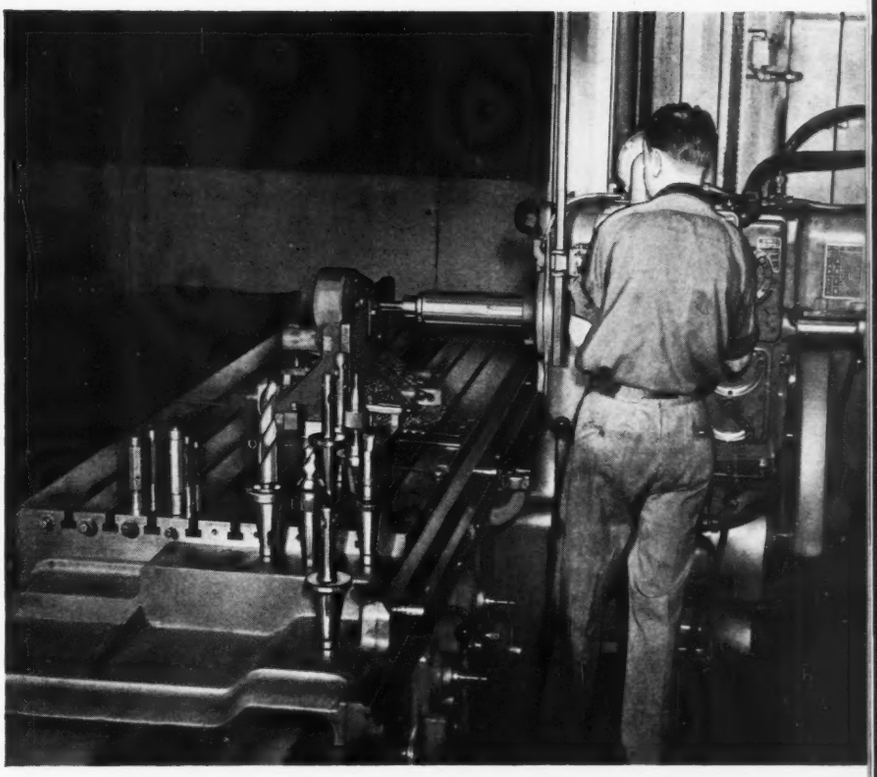


Fig. 4. Another view of the jig boring machine shown in Fig. 3. Examples of the tools employed in this set-up may be seen in both illustrations

low speed, the saddle moving to the right to operate the limit switch for the third time. Contact with the switch again applies a reversing potential to the feed motor, which stops. Through a time delay relay, the motor is allowed to reverse a few revolutions so as to release the tension in the gears and lead-screws of the saddle movement without disturbing the final position of the saddle. The saddle position is then within 0.0001 inch of that corresponding to the setting of the plug in the location rod.

One motor is used for the feed and positioning of both the saddle and spindle slides, but the spindle slide is operated by a screw of finer pitch and the over-run that occurs before the spindle slide reaches its final position is correspondingly smaller than the amounts mentioned for the saddle.

The spindle carries a Nitralloy bar, 3 inches in diameter, with a No. 5 Morse taper. There is a flange nose on the sleeve for mounting face milling cutters. The bar has 15 inches of automatic power feed for boring, with an extra 5 inches obtainable by resetting. The spindle has twelve quick-change speeds ranging from 30 to 800 R.P.M., and the bar is provided with six quick-change feeds ranging from 0.003 to 0.030 inch per revolution. A single lever serves to control the power feed and the rapid traverse of the boring-bar in both directions.

Lapping—A Skilled Art Becomes

Hand-Lapping has Always Been Slow and Costly, Requiring Skilled Artisans. Now Automatic Machines Consistently Lap Optically Flat Surfaces to Exceptionally Close Dimensional Tolerances and Fine Finishes at High Production Rates. First of Two Installments

By STEPHEN HAWXHURST
Lapmaster Division
Crane Packing Co.
Chicago, Ill.

LAPPING, as performed on Lapmaster machines, is a refined abrading process in which small amounts of material are automatically worn away from a surface by gently rubbing it with irregular motions over loose grains of abrasive on a flat lapping plate. Both the finish and flatness of the surface are improved by this rubbing action, which is produced by a continuous flow of free abrasive particles rolling between the surface being lapped and the lapping plate. Exceptionally flat (one-half light band—0.0000058 inch or less), ultra-smooth (1 to 2 micro-inches r.m.s.) surfaces can be consistently produced at relatively low cost and high production rates with unskilled operators on these automatic-cycle machines.

Hand-lapping has always been a slow, laborious, and costly operation requiring skilled workmen, and for this reason has been avoided whenever possible. However, the development of automatic transmissions for automobiles, tanks, and other vehicles has created a demand for highly accurate, flat, smooth surfaces, such as those produced by lapping. Since parts of these transmissions operate under internal hydraulic oil pressure above 200 pounds per square inch, and at temperatures as high as 350 degrees F., it is evident that accurate flat surfaces must be provided to prevent leakage. Also, as some of the castings of such transmissions are so intricately channeled that it is impractical to use gaskets, their mating surfaces must be flat and smooth enough to form a metal-to-metal oil-tight seal.

Other applications that require lapping today include the production of gas—or liquid—tight sealing surfaces on nozzles, seals, valves, etc. (in some cases eliminating the need for gaskets); the lengthening of tool life by sharpening cutting edges; and the production of accurately controlled dimensions. Dies employed in casting and molding are often lapped to impart a high finish to the parts being produced. Lapping is also used to improve electrical contact between flat surfaces; to sharpen the cutting blades on razors and clippers; and to provide a high finish for examining the microstructure of materials.

Another important use of the lapping process is to provide flat locating surfaces for subsequent machining or inspection operations. For example, valve and oil-pump bodies for automatic transmissions are lapped prior to precision boring for locating and chucking purposes. Otherwise, the work would be distorted when clamped, and the bored holes would not be straight.

A group of parts that are being economically lapped in production on Lapmaster machines is seen in Fig. 1. The part shown at *A* is a forged-

a Production Process

steel, multiple-port air valve, 14 inches in diameter, for use in a can-making machine. The castings seen at *B* are typical of automatic transmission parts that, because of impracticability of using gaskets, require metal-to-metal sealing. Other parts shown include a spinner plate *C*, used in the manufacture of nylon thread; thin spacer plates *D* for hydraulic applications; rotors *E* for refrigerant compressors; connecting-rods and caps *F*; and caps *G* for hydraulic and pneumatic cylinders and valves.

The basic requirements for successful hand-lapping—the use of loose abrasive, light pressures, moderate speeds, and relative movement of the work and lapping plate—have been incorporated in these automatic-cycle machines, while the principal objections—slow production and high cost—have been eliminated. Long or short parts, of various shapes and materials, can be lapped simultaneously on one machine. Economical use of such machines is therefore not limited to long production runs. Unskilled operators can be employed, since it is only necessary to load and unload the work-pieces manually.

There are several traditional misconceptions related to lapping which probably stem from the zealously guarded, personal techniques of the skilled hand-lapper. One of the most common beliefs is that cutting must be accomplished by abrasive embedded in the lapping plate. Consequently, it is believed that the lapping plate must be made from a material softer than that being lapped, in order to prevent abrasive from becoming embedded in the work. This is not the case. On the Lapmaster machines, the hard, cast-iron alloy lapping plate readily laps soft steels, cast iron, and non-ferrous metals such as aluminum, bronze, brass, etc., as well as hardened steel and carbides. Even such soft materials as lead and plastics can be effectively lapped with the same plate.

While some embedding of the abrasive in the plate does occur in lapping softer materials, it is negligible and the embedded abrasive does little or none of the cutting in a normal lapping operation. Any abrasive that becomes embedded in soft work-pieces is removed in subsequent cleaning and polishing operations. It is the generally accepted theory that the wearing action in lapping is caused by the rolling abrasive, each individual grain taking an occasional cut. Although no one knows what actually does take place, it is believed that the abrasive particles become wedged between the surface being lapped and the lapping plate, taking tiny cuts as they are forced through or knocked loose by other rolling abrasive grains.

While the surface produced by lapping is generally referred to as having a multi-directional lay, there is really no regular or predominant pattern. Lapping is a constant chip removal process, consisting of a multiplicity of cutting cycles that constantly overlap. The abrasive particles do not form long scratches in the surface, as is the case in honing or grinding, but produce a myriad of minute digs or cuts.

On the Lapmaster machine, Fig. 2, the work-pieces rest on a special-alloy cast-iron lapping plate, and are contained within conditioning or wear rings made from the same material as the plate. One of the three conditioning rings on the 12-inch machine illustrated has been removed to show the construction of the lapping plate. A work separator, made from laminated phenol-formaldehyde resin or other material, fits within each conditioning ring and keeps the work-pieces apart but allows them to rotate. When the parts

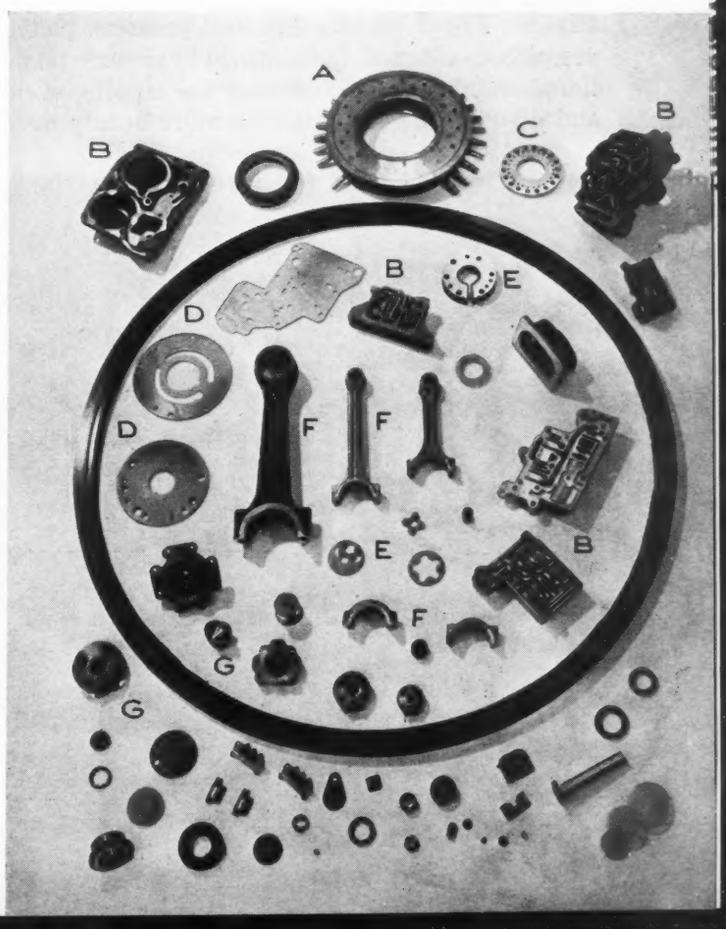


Fig. 1. Typical parts that are lapped on a production basis by the use of automatic-cycle machines

Fig. 2. One of the three conditioning or wear rings on this 12-inch machine has been removed to show the lapping plate

to be lapped are too light to exert sufficient pressure on the plate, pressure plates, such as the one seen within the rear conditioning ring, are placed on top of the work-pieces. Variable pressure can be obtained by substituting plates of different weights.

In lapping the flat mating surfaces of covers for the servo mechanism of an automatic transmission, Fig. 3, right-angle steel pressure plates are placed on top of the castings to provide additional weight, thus shortening the lapping cycle and distributing the pressure more evenly over the surface being lapped. Since the unit pressures exerted are always light, practically no heat is generated during lapping. If the work-pieces vary in thickness more than 0.010 inch or more than the amount of stock to be removed, a felt pad should be placed between the top of the work and the pressure plate.

A constant flow of fresh, sharp abrasive grains, suspended in a suitable vehicle, is directed from an agitator tank onto the lapping plate during the entire cycle. The compound flows by capillary action down a conductor track or feed wire to the side of one of the conditioning rings. Flow of the compound through a metering orifice in the power-agitated tank, which is controlled by a solenoid valve, begins as soon as the lapping plate driving motor is started, and is automatically stopped—together with the lapping plate—at the end of a predetermined time cycle, set by means of a clock. Rate of flow approximates that at which the abrasive grains break down during lapping. The lapping plate contains radial serrations that serve as exit paths for spent abrasive and removed material, as well as reservoirs for fresh abrasive, which is drawn upward by capillary action when large surface areas are being lapped.

The work, work separators, and conditioning rings are rotated by the power-driven lapping plate through friction. Surface speeds employed in lapping are not of critical importance, but are generally less than 600 feet per minute. Accuracy of the lapping plate is continuously main-

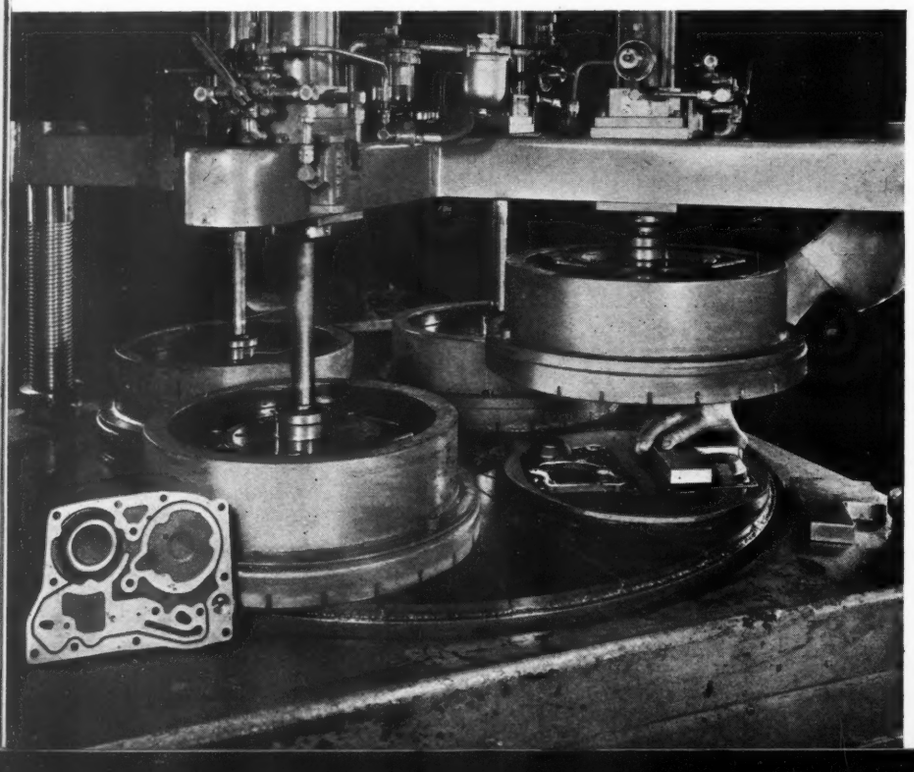


Fig. 3. In lapping covers for automatic transmissions, pressure plates are placed on the castings to produce added weight

tained by the reconditioning action of the rings, which wear the plate faster than the workpieces. The conditioning rings, which are slotted on 24-inch and larger lapping machines, as seen in Fig. 4, also spread the abrasive evenly over the lapping plate.

The spent lapping compound is directed by a combination of gravity and centrifugal force, through the serrations in the lapping plate and into a catch basin surrounding the plate. Since the compound is contaminated by the removed material and the abrasive grains are reduced in size—and no longer sharp—it is disposed of. The abrasive vehicle can be reclaimed by a settling and separation process, but it is seldom considered worth while because of the cost. The efficiency with which abrasive is used in lapping on machines of this type can be appreciated from the fact that the average cost of operating a 12-inch Lapmaster is only 25 cents a day.

Machine lapping still retains, in effect, the traditional "figure eight" movement employed in hand-lapping. Any point on the parts being lapped, except the exact center of the center piece, roughly traces this movement due to the rotation of both lapping plate and conditioning ring.

Pneumatic lifts can be provided on the lapping machine, as seen in Fig. 4, to facilitate loading and unloading. Such lifts can be arranged to raise just the conditioning rings, both the conditioning rings and the pressure plates (when such plates are employed), or the pressure plates only. If the surfaces being lapped have large areas, it is quite difficult to raise the parts from the plate. In such cases, it is necessary to lift the conditioning rings (and pressure plates), and slide the parts off the side of the lapping plate.

For lapping high parts, the machine can be equipped with a roller-bar attachment, Fig. 5, to retain and adjust the conditioning rings. With this device, rollers located on arms that are adjustably mounted on a ring surrounding the lapping plate hold the conditioning rings in place, but permit them to rotate. The illustration shows a 48-inch Lapmaster employed by the Continental Motors Corporation, Muskegon, Mich., to lap aircraft type cylinder barrels for a military tank engine. Only one minute is required to lap a load of these cylinder barrels.

The choice of abrasive to be employed in lapping can only be determined by experience. It varies with the abrasive resistance and hardness of the material to be lapped, the condition of the surface, the amount of stock to be removed, the production required, the surface finish desired, etc. Silicon carbide and aluminum oxide are the abrasives most widely used in lapping.

Silicon-carbide grains, which are slightly harder than aluminum oxide, have a jagged crystalline structure, and are generally longer than they are wide. An advantage of this type of abrasive is that each individual grain breaks down into crystals like itself. Aluminum-oxide grains, however, which are sharp-cornered and more cubical in shape, break down, but not into a multiplicity of themselves. Such grains become rounded, and will produce a finer finish, but at a slower cutting rate, than silicon-carbide abrasive of similar grain size.

Aluminum-oxide abrasive is most generally employed, particularly for fine finishes and softer metals, such as aluminum, brass, soft steels, etc. Silicon-carbide abrasive of the same grit size cuts faster, but produces a rougher finish, and is usually restricted to the lapping of hard steels,

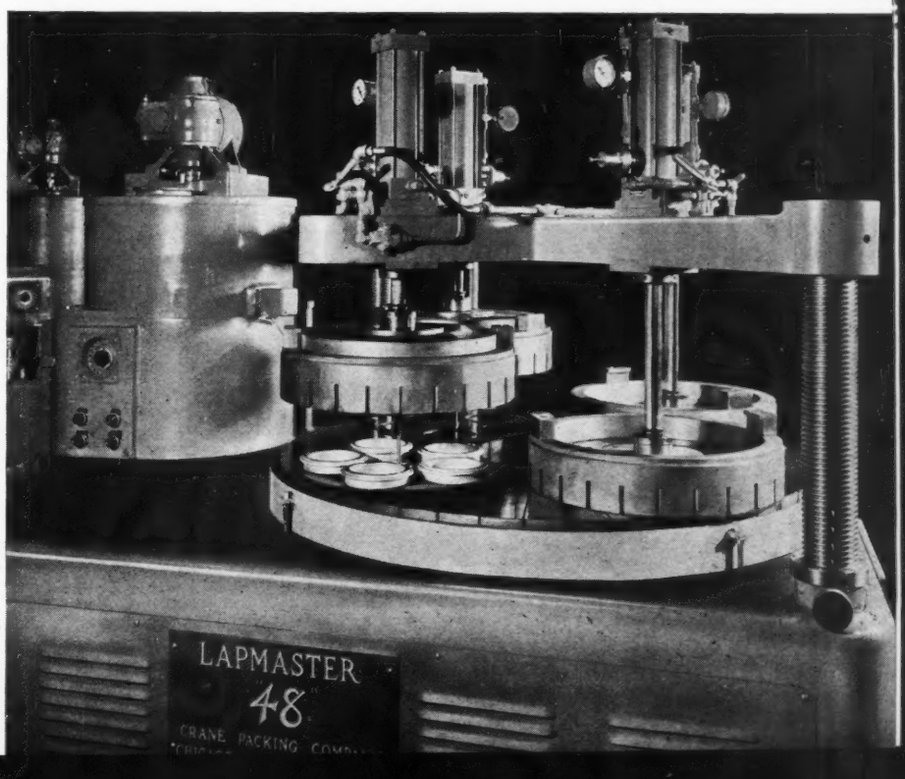


Fig. 4. Pneumatic lifts facilitate loading and unloading by raising the conditioning rings or pressure plates, or both

carbides, cast alloys, etc. Boron carbide is the hardest abrasive customarily employed in lapping; crushed diamonds (bort) are seldom used because of their high cost.

The size of abrasive grains (up to a fineness of 400) is specified by a number that represents the approximate number of openings per linear inch in the screen used to size the grain. Grains finer than 400 (mesh or screen size) are specified in microns, one micron representing a particle having an average diameter of approximately 0.001 millimeter.

As a rule, the coarsest abrasive silicon carbide employed in lapping is 220 mesh, while the finest aluminum oxide is about 9 1/2 microns (900 mesh). The most widely used grain size is 12 1/2 microns. A grit size of 400 is generally the coarsest aluminum-oxide abrasive employed for lapping. Silicon-carbide abrasive of 220 grit size permits fast stock removal for rough-lapping, and is suitable for producing a surface finish of 30 micro-inches r.m.s.

Finer grain sizes are used, of course, to produce smoother surface finishes, and coarser grains where more rapid cutting is necessary or where large surface areas are to be lapped. While 400-grit aluminum-oxide abrasive can produce a surface finish of about 4 micro-inches r.m.s., 900-grit abrasive will give a finish of 1 micro-inch or less.

The vehicle in which the abrasive is suspended serves two purposes. First, it acts as a lubricant, separating the work-pieces from the lapping plate sufficiently so that the abrasive grains can move freely without supporting the entire weight of the work-pieces and pressure plates. Second, it serves as a carrier for the abrasive, allowing it to be spread uniformly over the lapping plate and to flow away along with removed material—when cutting has been achieved.

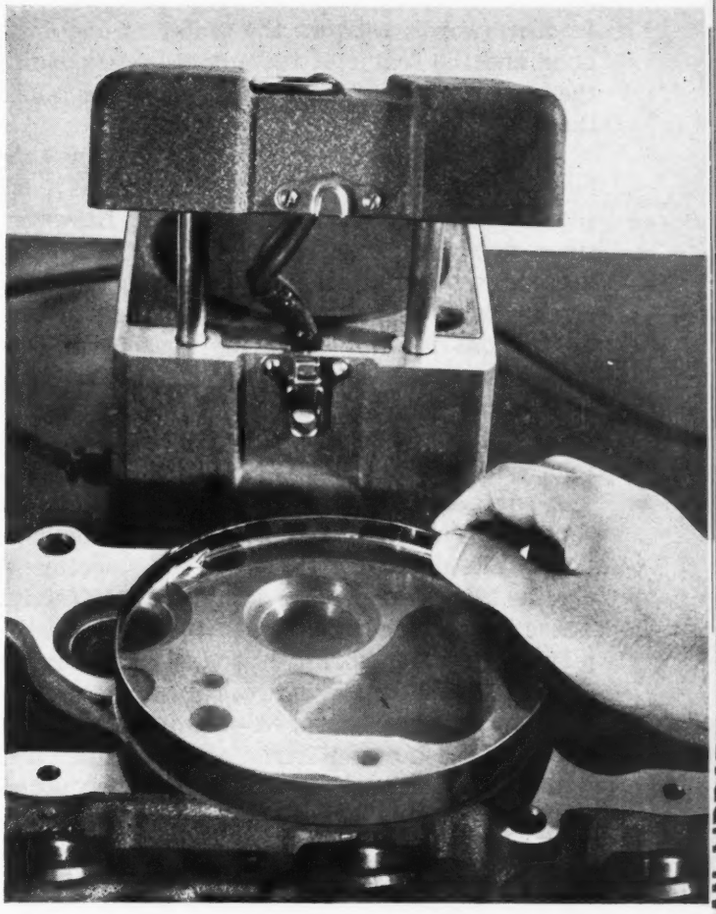
The abrasive vehicle is generally a petroleum base of low viscosity, with additives which increase the body, strength, and cohesion (for capillary action), and keep the abrasive in suspension. A vehicle of slightly higher viscosity is sometimes used for coarser grit abrasives. A water-base or water-soluble vehicle is sometimes employed where it is difficult to remove oil from the parts being lapped, as is the case with ceramics or other porous materials. Although grease is occasionally used in hand-lapping, such a vehicle is not fluid enough for machine lapping.

The ratio of abrasive to vehicle used in lapping any particular material or part can only be determined by trial and error, or by experience. However, an average mixture contains 7 ounces of dry abrasive to 1 gallon of vehicle.

While a constant flow of lapping compound is generally directed on the lapping plate during the entire cycle, it can be halted near the end of the cycle to obtain a brighter finish on the part being lapped. This procedure is not generally practical in production, but it is employed in lapping carbon. In that case, when the free flowing abrasive is stopped, the lapping plate is flushed with oleum spirits and the parts are actually

Fig. 5. For lapping high parts, a roller-bar attachment is employed to retain and adjust the conditioning rings

Fig. 6. An optical flat 6 inches in diameter is shown being employed to check the flatness of a lapped engine head



wet polished, using any abrasive that has become embedded in the lapping plate.

The accuracy of lapping depends on the accuracy of the lapping plate. Hand-laps must be periodically reconditioned by working three plates together. The plate on Lapmaster machines is lapped within light band specifications for flatness, and normally retains its accuracy due to the wearing action of the conditioning rings. However, the plate should be checked periodically by means of a bevel-edge straightedge of suitable length. If light appears between the lapping plate and the straightedge, adjustment should be made by repositioning the conditioning rings.

In their normal position, the conditioning rings are equally spaced with relation to the inner and outer peripheries of the lapping plate. If the surfaces being lapped become concave, this indicates that the center surface of the lapping plate is higher than its outer surface, and one or more of the conditioning rings should be moved in toward the center.

On the other hand, if a convex surface is produced in lapping, the center surface of the lapping plate is low, and one or more of the conditioning rings should be moved out from the center. This adjustment is made through a crosspiece assembly which is mounted in an elongated slot on an upper support member. In cases where a roller-bar attachment is used, the required adjustment can be effected by moving the roller bars in or out.

It should be emphasized that lapping can generate a surface that is both flat and smooth, but it should also be pointed out that a surface need not be flat to be smooth. The degree of flatness of a surface can be defined as the amount of deviation of any part of the surface from a theoretically perfect horizontal plane. This is normally determined by the optical (light-wave) method, measurements being made directly in terms of the wave length of light. The lapped surface, which has been cleaned and polished to reflect light, is placed under monochromatic light (light of one wave length or color), and an optical flat is placed on this surface (Fig. 6).

While an optical flat 6 inches in diameter is being used to inspect this lapped engine head (which has a flatness of about five light bands), a 3-inch diameter flat is more generally used in production. Optical flats, made from fused quartz or Pyrex glass, are lapped to within 0.000001 inch of absolute flatness.

A thin wedge of air separates the lower surface of the optical flat from the lapped surface to be inspected. When each ray of light from the monochromatic source reaches the lower surface of the optical flat, it is divided into two rays, one being reflected immediately, and the other continuing downward until it is reflected from the lapped surface of the work. The amount of space between the flat and lapped surface determines whether these rays reinforce each other and produce visible light bands or interfere with each other, forming dark bands.

Light-wave bands visible through the optical flat are inspected. If bands are not visible, it is probably due either to foreign particles, such as dust, holding the flat away from the lapped surface or to the presence of moisture or oil that may cause the flat and lapped surface to adhere too closely. Straight, parallel, and evenly spaced bands indicate that the lapped surface is flat. The amount of flatness error is indicated by the curvature of the bands.

For example, if an imaginary line connecting the ends of any one dark band intersects the next dark band, the error in flatness is one light band. If the line cuts the second band, the error is two light bands, etc. An error of one light band represents 0.0000116 inch, using helium light.

In other words, between the center of one dark band and the center of the adjacent dark band, the level of the lapped surface has risen or fallen that amount.

As previously mentioned, a flatness of one-half light band or less can be produced consistently on the Lapmaster machine. However, since such a high degree of flatness is seldom necessary, the time required for lapping in general production is reduced, and a flatness of two light bands is most commonly specified. This amount of flatness is adequate for most purposes, and when produced on seals, permits them to withstand liquid pressures of 3000 pounds per square inch or more.

A surface finish of from 2 to 3 micro-inches r.m.s. is generally achieved in production lapping. The exact degree of surface smoothness obtained, however, varies with different factors. These include the grain size of the abrasive employed, a coarser abrasive producing a rougher surface; the hardness and resistance to abrasion of the material being lapped—the harder or more abrasion resistant a material, the finer the finish with a specific size abrasive; the pressure exerted on the work during lapping, a rougher finish being produced with increased pressure; the vehicle employed as a carrier and lubricant in the lapping compound, a vehicle of heavier body producing a finer finish; the ratio of abrasive to vehicle, a larger proportion of abrasive in the compound producing a rougher finish; and other conditions.

It is seldom practical in production lapping to vary any of these factors except abrasive grain size and the ratio of abrasive to vehicle. If the surface finish produced in lapping is not as smooth as required, a finer abrasive is employed or, occasionally, more vehicle is added to the compound. In production lapping, it is possible, but generally impractical, to produce a surface finish of 1 micro-inch r.m.s. or less on hard material by using a fine abrasive and a long lapping cycle. A more economical method to secure this degree of smoothness is to lap the surface to 2 or 3 micro-inches and then polish it to the required finish of 1 micro-inch.

Parallelism of lapped parts can be held to any tolerance that can be accurately measured. As an extreme example, flat surfaces on opposite sides of one part were lapped parallel within 0.000002 inch. However, such precise tolerances necessitate long lapping cycles and extreme care while lapping. On so-called "single-lap" machines, such as the Lapmaster, it is desirable to have three or more work-pieces within each conditioning ring when parallelism of several surfaces on each part is required. The greater the number of parts lapped simultaneously, the higher the degree of parallelism that can be maintained.

In lapping several parts required to have parallel surfaces to close limits, one side of each part is lapped flat first, placing a felt pad and pressure plate on top of each group of work-pieces. Then the parts are turned over, the pressure plate is placed on the lapped surfaces (omitting the felt pad), and the other side of the parts is lapped flat and parallel. The pressure plates, which have previously been lapped flat, rest first only on the high spots of the work surfaces or on the highest work-pieces, but as lapping progresses, they eventually rest evenly on all parts. If only one or two pieces were being lapped, the pressure plate would rock and parallelism would not be automatically generated. In such cases, each work-piece must be individually weighted in order to lap parallel surfaces.

The second, and concluding, installment of this article, which will appear in May MACHINERY, will discuss stock removal rates, work separators and fixtures used in lapping, and the cleaning and polishing of lapped parts. Examples of modern production lapping will also be described.

* * *

Hard Finishes for Aluminum Produce Abrasive-Resistant Surfaces

New hard coatings for aluminum that provide high resistance to abrasion can now be produced by a license arrangement granted by the Aluminum Co. of America, Pittsburgh, Pa. These coatings have special value where hard, long wearing properties, coupled with light weight are essential, as in surfaces subjected to abrasion or erosion. They have been used extensively in aircraft equipment and orthopedic appliances.

The wear-resistant finishes are anodic-oxide coatings which form an integral part of the metal they protect. Intrinsically hard, aluminum-oxide coatings cannot be chipped or flaked from the base metal, and the newer types afford superior resistance to abrasive action.

* * *

Welding Galvanized Metal

Galvanized angle-irons can be welded without impairing the efficacy of the zinc coating by employing a Heliarc torch and Everdur filler rod, according to The Linde Air Products Co. There is some loss in the thickness of the coating, but the welding method does not appreciably decrease the corrosion resistance.

Jigs Designed for Drilling Closely Spaced Holes

By ROBERT W. NEWTON

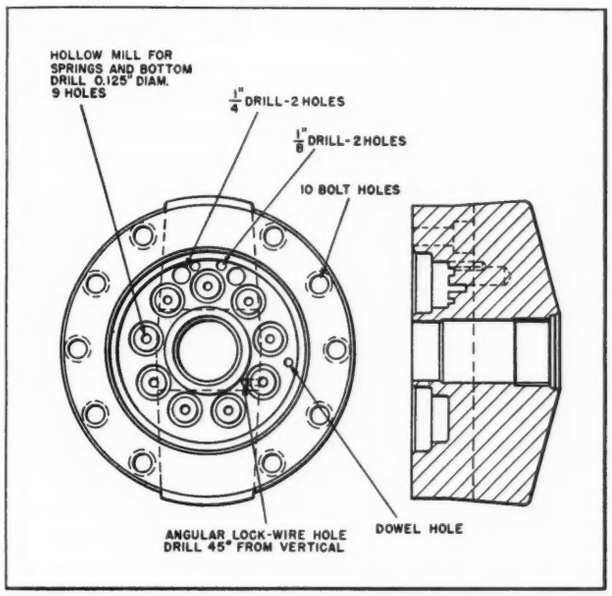

HOLLOW MILL FOR SPRINGS AND BOTTOM DRILL 0.125" DIAM. 9 HOLES
1/4" DRILL-2 HOLES
1/8" DRILL-2 HOLES
10 BOLT HOLES
ANGULAR LOCK-WIRE HOLE DRILL 45° FROM VERTICAL
DOWEL HOLE

Fig. 1. Cover of a high-pressure hydraulic pump used in aircraft. Holes are closely spaced to save weight

THE elimination of unnecessary weight is essential to the successful operation of aircraft. To save weight in high-pressure hydraulic pumps used in airplanes, holes in the pump covers were spaced very close together, as shown in Fig. 1. The production of these closely spaced holes demanded ingenuity in designing drill jigs that would be economical to build and operate.

The jig seen in Fig. 2 is used in drilling the ten bolt holes and the two 1/8-inch and two 1/4-inch diameter holes in the bottom of the cover. Guide holes for drilling the 1/8- and 1/4-inch holes are provided in the locating plug instead of attempting to use conventional drill bushings, which would have to be overlapped because of the close spacing of these holes.

This jig is of the common plate type, with its hardened locating plug ground to provide a slip fit in the bore of the work-piece. The plug is accurately positioned in the counterbored bushing plate, being located radially by means of a dowel and secured to the plate with three socket-head cap-screws. As mentioned, four accurately located, lapped holes are provided in the plug to guide the 1/8- and 1/4-inch diameter drills. There are two large-diameter holes in the bushing plate, each hole providing clearance for one of the 1/8-inch drills and one of the 1/4-inch drills.

Ten hardened, headed type drill bushings are pressed into the under side of the bushing plate. The top surfaces of the bushing heads are ground flush with each other, and serve as hardened buttons on which the work-piece rests when it is clamped.

The bottom surfaces of the four legs, which are pressed into the bushing plate, are also ground flush with each other. The jig rests on these surfaces while the holes are being drilled

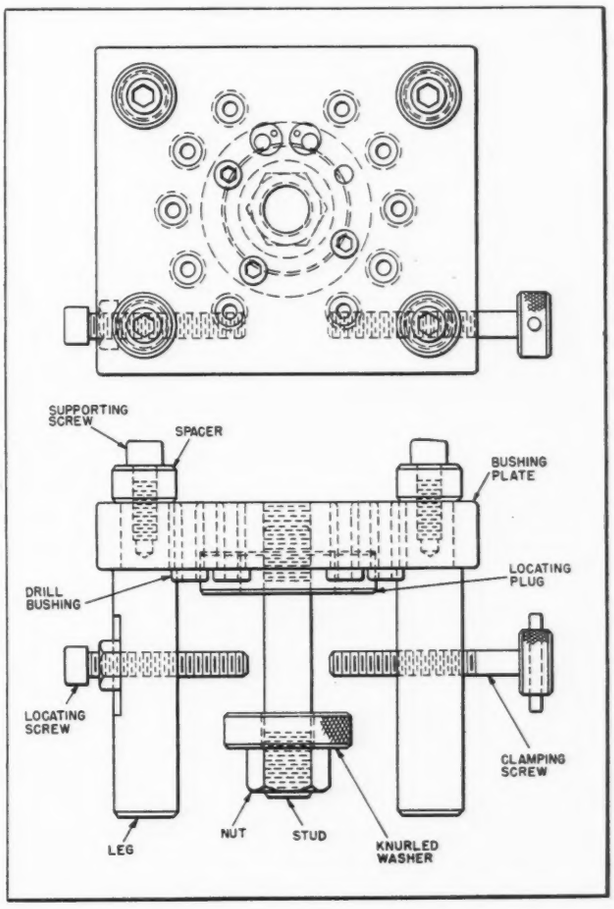


Fig. 2. Jig used in drilling ten bolt holes, two 1/8-inch holes, and two 1/4-inch holes in pump cover seen in Fig. 1

in the pump cover. A supporting screw and spacer are fitted to the upper end of each leg. The heads of these screws are hardened and ground flush so that they serve to support the jig when counterboring the under side of the bolt holes in the work.

A socket-head locating screw, fitted with a hexagonal check-nut, is screwed into the side of one leg. This screw is adjusted to locate the work radially, and then locked in place by means of the check-nut. Into the leg opposite this screw is fitted a knurled-head clamping screw, which has a pin driven through the head to provide a hand-grip for applying pressure. By tightening this screw, the web on the work-piece can be clamped against the locating screw. It is necessary in counterboring two of the bolt holes in the pump cover to loosen both the locating and the clamping screws to remove them from the path of the counterboring tool. After this is done, a pin is inserted into one of the bolt holes previously drilled to locate the pump cover radially with respect to the bushing plate.

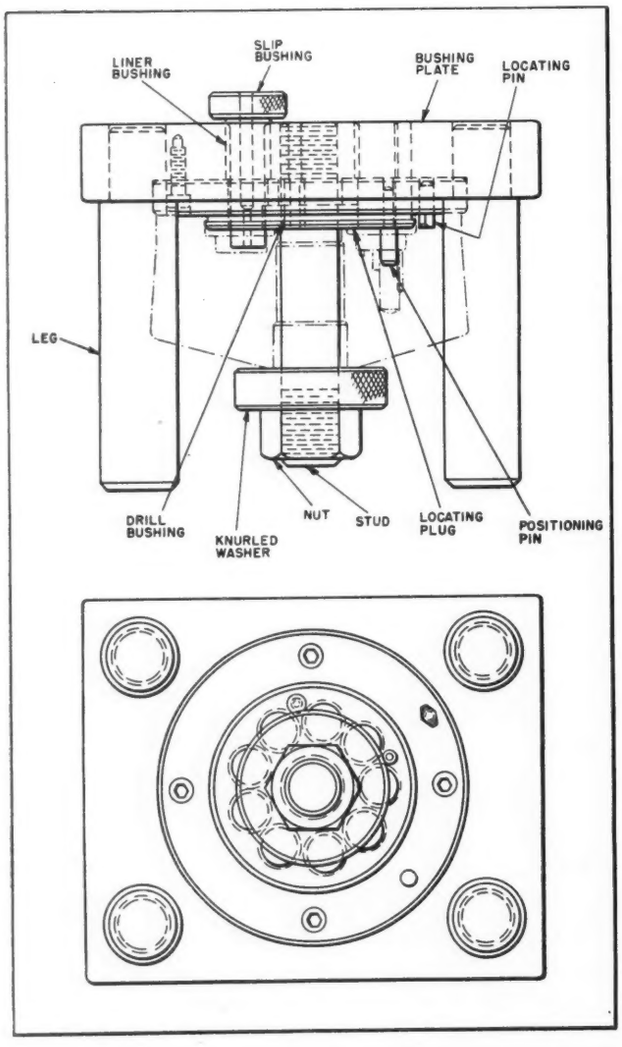


Fig. 3. Nine spring seats in the pump cover are hollow-milled and 0.125-inch holes in the center of the seats are drilled and reamed with this jig

In loading the jig, the work-piece is slipped over the locating plug and pushed in place against the heads of the drill bushings. After adjusting the locating screw and tightening the clamping screw, a stud is inserted through the bore of the pump cover and a clearance hole in the locating plug and screwed into the bushing plate. A knurled washer and hexagonal nut are provided on the lower end of the stud as a hand-grip for clamping the work firmly in place. The nut and stud are held together by a pin. If the jig is used sufficiently to wear out the thread that the stud engages in the bushing plate, a hardened, head type, threaded bushing can be driven into the top of the plate.

Thin-walled bushings are successfully used on the drill jig shown in Fig. 3, which is employed to hollow-mill the nine spring seats, drill and ream the 0.125-inch diameter holes in the center of these seats, and drill the dowel-hole in the pump cover. A bushing for guiding the dowel-hole drill is provided in the locating plug of the jig to avoid the overlapping of bushings.

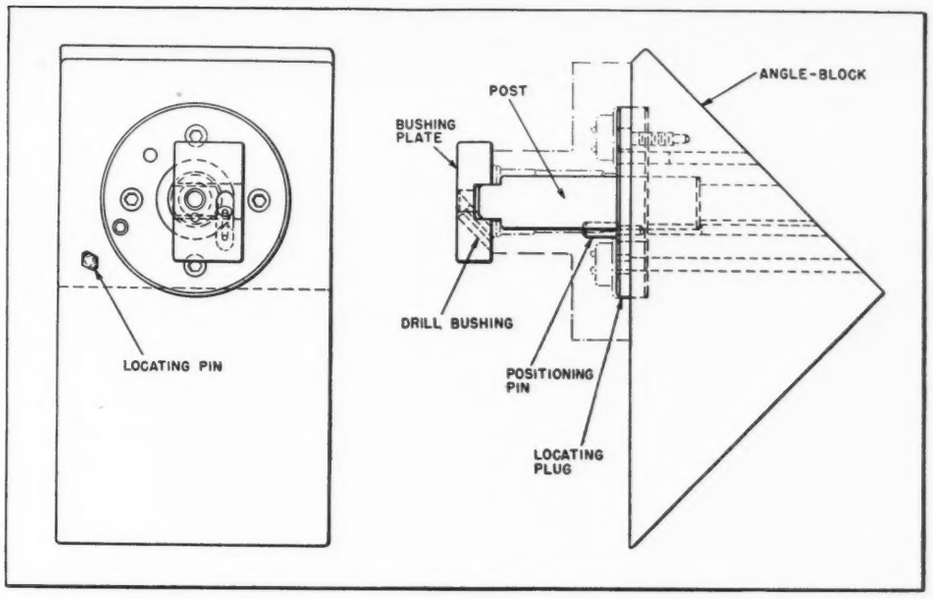
This jig is also of the plate type, and its locating plug is ground to provide a slip fit in the bore of the work-piece. The shoulder ground on the plug is of sufficient diameter to provide a hardened resting surface for the pump cover to be machined. As with the previous jig, the plug is accurately positioned in the counterbored bushing plate, being located radially by means of a dowel and secured to the plate with four socket-head cap-screws.

A hardened and ground locating pin, provided with a flat on one side and accurately positioned in the locating plug, is a slip fit in one of the bolt holes previously drilled in the pump cover. A positioning pin, also pressed into the locating plug, enters one of the 1/4-inch diameter holes in the work, thus insuring that the locating pin will enter the proper bolt hole and that the work will be correctly positioned radially.

Nine hardened liner bushings are pressed into the bushing plate. The bores of these bushings are ground to the maximum size specified for the outside diameter of the spring seats in the work-piece, the liner bushings thus serving as guides for the hollow mill employed to machine these grooves.

A hardened slip bushing for drilling and one for reaming the 0.125-inch diameter holes in the center of the spring seats are made to fit within each liner bushing. In order to leave a minimum of 1/32 inch between adjacent holes in the bushing plate, the liner bushings had to be made with a wall thickness of only 3/64 inch. Although

Fig. 4. Combination angle-block and drill plate for drilling the angular lock-wire hole in the pump cover



such thin-walled bushings are not usually considered good practice, they have been used successfully at times in this and other jigs.

A hardened drill bushing for producing the dowel-hole in the pump cover is accurately positioned in the locating plug, and clearance for the dowel-hole drill is provided in the bushing plate. Sufficient wall thickness is thus available between the clearance hole and the two adjacent liner-bushing holes in the bushing plate. If this drill bushing had been placed in the bushing plate, it would have overlapped the two liner bushings.

Four legs, on which the jig rests during drilling, are pressed into the bushing plate. The work is clamped tightly in the jig by means of a knurled washer and nut on the end of a stud that passes through a clearance hole in the locating plug and is screwed into the bushing plate.

A simple combination angle-block and drill plate, Fig. 4, is provided for drilling the lock-wire hole in the pump cover. Clamping of the work is unnecessary when drilling this short, small-diameter hole, since close accuracy is not required and little pressure is exerted during drilling. This jig consists of a 45-degree, cast-iron angle-block which is counterbored to provide a slip fit for a hardened locating plug. The plug, positioned radially by a dowel and secured to the angle-block with four socket-head cap-screws, is a slip fit in the bore of the work.

A post, passing through a clearance hole in the locating plug and driven into the angle-block, is located radially by a pin driven into the periphery of the post. The work is loaded by sliding it over the post and on the locating plug and a locating pin. This pin, which is accurately positioned in the angle-block, slides into one of the bolt holes previously drilled in the work. A positioning pin, pressed into the locating plug, enters one of the 1/4-inch diameter holes in the part, thus preventing the work from being placed on the angle-block in the wrong position.

The outer end of the post is turned down and provided with flats on both sides to fit the bushing plate. This plate, into which a hardened drill bushing has been pressed at the required angle, simply rests on top of the work, clamping being unnecessary.

* * *

"Ductile Iron" Shows Marked Advantage for Doors of Forging Furnaces

One example of improved service provided by the adoption of "Ductile Iron" is the doors of steel forging furnaces used at the General Electric Co.'s River Works, West Lynn, Mass. These furnaces operate at interior temperatures as high as 1950 degrees F., and, as a result, the gray cast iron formerly used deteriorated quite rapidly from growth, warpage, and scaling. A typical gray iron door required replacement after one week's service. By contrast, the average life of "Ductile Iron" doors is estimated by the company to be around 300 days. On the basis of the total number of furnaces at the G-E Forge Shop, the improved service attained with "Ductile Iron" doors resulted in an estimated saving of $25,000 per year.

The Thomson Laboratory of General Electric conceived the idea of using "Ductile Iron" for this application. The castings are produced by the Taylor & Fenn Co., Hartford, Conn., which is licensed under International Nickel Co. patents to produce the new material.

Unusual Chromium-Plating

CHROMIUM-PLATING is widely used today for building up worn machine parts and gages; producing a hard, wear-resistant surface on rolls and ball bearings; reducing friction and wear between cylinders and piston-rings; and increasing the life of dies, molds, cutting tools, drill jig bushings, and instruments. Practically every application of chromium-plating presents an individual problem related to shape and size of the part, the base material, the thickness of plating required, size tolerances, and other considerations.

To facilitate experimentation and research along these lines, the Cro-Plate Co., Inc., Hartford, Conn., has set up the Cro-Engineering Service Division. One of the most interesting problems worked out by this division was the improvement of the durability of printing rolls. An idea of the success of this work will be obtained from the fact that one chromium-plated roll has run for a million and a half impressions.

The problem of chromium-plating printing rolls is increased by the need for keeping the cylinders concentric at all points to very close tolerances. In color work, the same tolerances must be maintained on the diameter of all cylinders. The eveness of deposit is controlled by fixtures that conform closely to the shape of the different rolls, and that are made to accommodate various lengths and diameters.

The doctor blade is one of three sources of friction in a gravure cylinder, the others being the paper passing over the cylinder surface, and the ink as it is lifted from the cells (hence the necessity of plating the sides and bottoms of the cells). This friction is often aggravated by tremendous pressure from the impression cylinder.

These problems had to be considered by Cro-Plate engineers in designing fixtures for compounding baths to be used in plating gravure cylinders. For this work, concentricity must be preserved within 0.0001 inch. As a result, the fixtures are equipped with shields that prevent high density at edges, lips, etc., of the cylinders. The anode is curved according to the periphery of the roll. This anode follows the contour of the surface—where wear is heaviest—so as to produce the greatest deposit at that point. The sides and bottoms of cells receive a smaller deposit because they are subjected to only one source of friction—the removal of ink. The thickness of the chromium plate on the cylinder is only 0.0003 inch, which means that the overall diameter is increased 0.0006 inch. Because of the accuracy of the methods, a set of color cylinders, if kept identical up to the plating stage, can be delivered with identical diameters after plating.

Another operation that requires careful consideration is the chromium-plating of 0.30-caliber sportsman rifle barrels. Six barrels are plated at one time to a thickness of 0.0001 inch on a side for a length of 20 inches. No subsequent grinding or lapping is required, and the plated surface provides an increase in the velocity of the bullet, as well as corrosion resistance.

In this operation, the anodes are centered through the axis of the barrels within 0.002 inch total indicator reading. The solution employed is standard, being in the proportion of 100 parts of chromic acid to 1 part of sulphuric acid, and operating at a temperature of 131 to 132 degrees F., with a 30-ampere current. Barrels remain in bath six minutes.

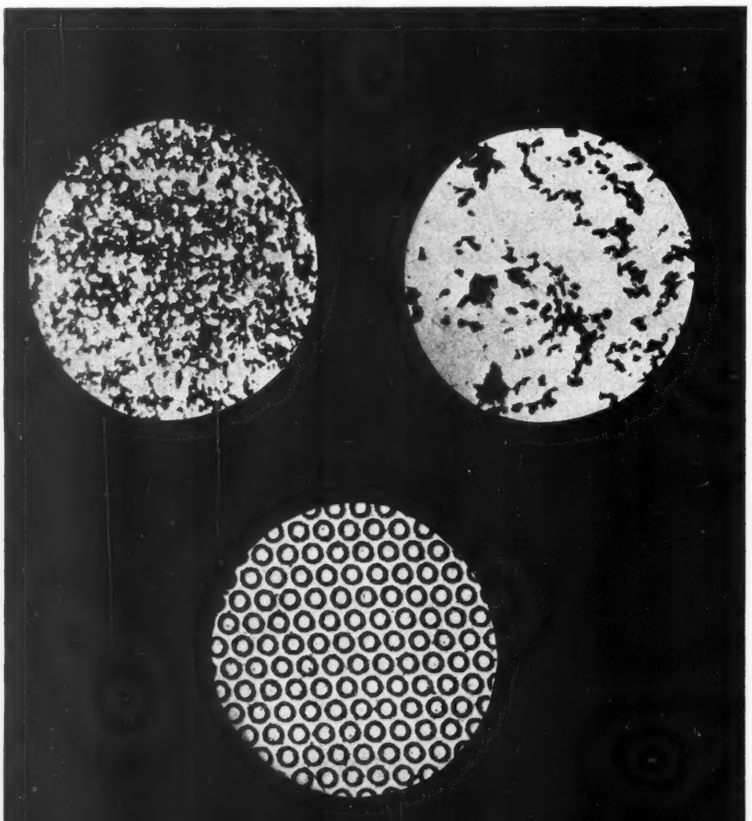


Fig. 1. Photomicrographs showing comparative uniformity of porous chromium surfaces produced by etching after plating (top) and etching before plating, using a photographed screen pattern as a mask (bottom)

Problems

By
ALAN W. BROWN, Director
Cro-Engineering Service Division
The Cro-Plate Co., Inc.

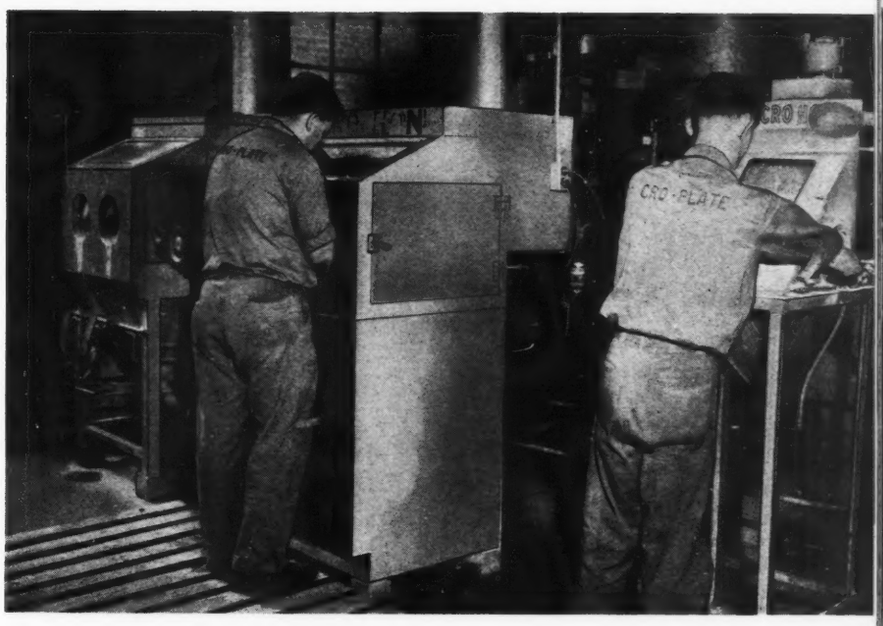


Fig. 2. Wet-blasting equipment used to remove oxide film from work that is to be chromium-plated directly, without previous coatings. This equipment is also used for deburring, descaling, stock removal, and general surface cleaning

It may be of interest to note that the equipment used for performing this work is the standard chromium-plating unit built by the Cro-Plate Co. This unit, known as the "Cro-Plater," includes a 45-gallon lead-lined tank, heated by two strip type electric elements at the bottom. Selenium rectifiers, cooled by a blower, provide a source of direct current up to 500 amperes at 0 to 12 volts. Fumes from the plating tank are evacuated by means of another blower. The plating controls include a switch by means of which the polarity of the anode and cathode may be reversed, as well as a circuit selector switch that controls current input to the tank. The instruments include a voltmeter, a main ammeter, a vernier ammeter, and a variable rheostat for controlling the tank temperature within plus or minus 2 degrees F.

One of the most interesting problems to be worked out by this division was that of producing a porous chromium surface for retaining oil in steel parts and reducing the "wearing in" time required in mating parts that ordinarily need a long period of lapping action in operation before they fit properly. The porous surface is achieved by etching the base metal and then plating. A high degree of uniformity in porosity was obtained by first photographing a fine-mesh screen pattern on the work surface to act as a mask during the etching process. The round recesses, caused by the etching action in pulling metal from the unmasked surfaces, are plated along with the rest of the surface. As a result, a fully plated surface, longer life, and greater wear resistance are achieved.

This is an advantage over some other methods of producing porous chromium surfaces in which the plating current is reversed to etch the work surface after plating, since the etching action pulls the plating out in spots, thus leaving unplated areas that may corrode. The photomicrographs shown in Fig. 1 illustrate the comparative results. The Cro-Plate porous chromium surface is seen at the bottom, and porous chromium surfaces obtained by another process at the top.

An extremely important operation usually performed prior to plating is wet-blasting. As applied in this plant, wet-blasting permits chromium to be plated directly on the base material. A typical blasting operation might employ a 325-mesh abrasive (silicon dioxide) for ten to fifteen minutes, with a tip velocity of 1600 feet per second, after which the work is rinsed and plated.

To facilitate wet-blasting of work of all types before chromium-plating, a unit known as the Cro-Hone pressure blaster, which has no pump or other moving parts, has been developed. Three of these units are illustrated in Fig. 2, the one at the left being equipped with a rotating barrel for automatically blasting small parts in large quantities. The Cro-Hone unit operates at shop air-line pressures of 80 to 120 pounds per square inch, but by utilizing internal air pressure in conjunction with an air ejector and a mixer gun, the abrasive solution is accelerated to tremendous speeds.

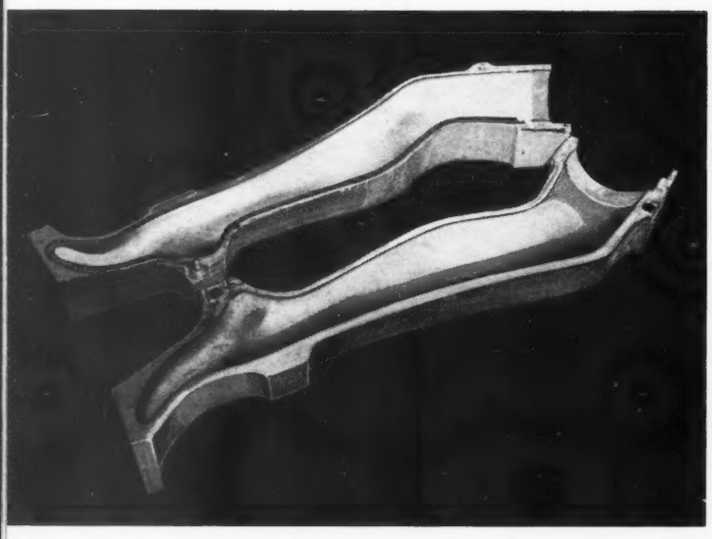


Fig. 3. Die-casting for a manikin leg mold. This part was chromium-plated directly on the aluminum surface

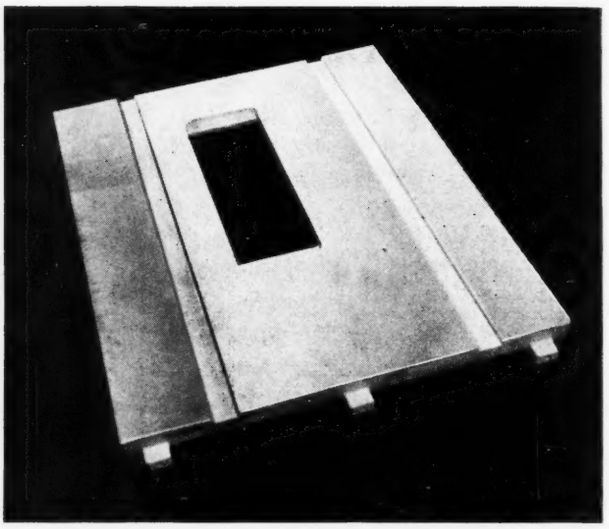


Fig. 4. An aluminum saw table, chromium-plated on the top and on the sides of guide slots to prevent scratches

In operation, the opening of a valve admits air to a line that evacuates a pressure tank, causing the air-agitated solution to be siphoned from a 35-gallon hopper to the pressure tank in approximately thirty seconds. When the tank is filled, a main air-blast valve is opened by means of a knee-operated lever at the front of the cabinet. The air blast enters the tank to pressurize the abrasive solution and passes on up to the gun.

Thus, two pressures are developed to propel the solution from the tank and out of the gun nozzle. The first of these is the pressure within the tank, and the second is the slightly lower pressure at the gun. The abrasive solution flows up into the gun as the result of the difference between these two pressures, and there the air carries it out of the nozzle as a jet. After blasting the work, the solution is collected in the hopper.

Because of the erosive nature of the blast, abrasives ranging in size from 45 to 5000 mesh can be used, so that either an increase in the rate of coverage or very high finishes can be obtained. Uniform surface finishes are produced by controlling the agitation of the abrasive solution to maintain a constant water-abrasive density.

One of the most outstanding uses of wet-blasting in this plant was in solving the problem of chromium-plating directly on aluminum, without the usual intermediate steps of anodizing or subjecting the work to prior deposits of zinc, copper, and nickel. The corrosion resistance of aluminum is the result of an oxide coating that forms immediately upon contact of the atmosphere with the metal surface. It is this oxide coating that normally makes the chromium-plating of aluminum difficult.

After cleaning the work by wet-blasting, however, the aluminum surface retains a sufficiently thick coating of the suspension of abrasive and water to prevent action of the air. This coating remains long enough to permit the aluminum to be immersed in the plating bath, where the chemically inert coating is washed away. For maximum efficiency, the Cro-Hone machine is placed next to the plating tank.

Fig. 5. Alloy-steel breeches for a 57-millimeter recoilless rifle. At the right may be seen the internal flange, under the lugs, to be chromium-plated on the top and side surfaces. A protective coating of grease covers this section of the part at the left

A typical example of this process is the direct plating of the cast-aluminum mold shown in Fig. 3. The entire inner contour of this manikin leg mold is chromium-plated to a uniform thickness of about 0.0015 inch, using a conforming anode. It has been found that chromium can be deposited directly on this part at the rate of 0.001 inch per hour with a standard plating solution and a current density of 1.5 amperes per square inch. The hardness of the deposit ranges between 75 and 82 Rockwell C. It is of interest to note that because of the porosity of the cast surface of this part, it was soaked in water for one hour after the plating operation.

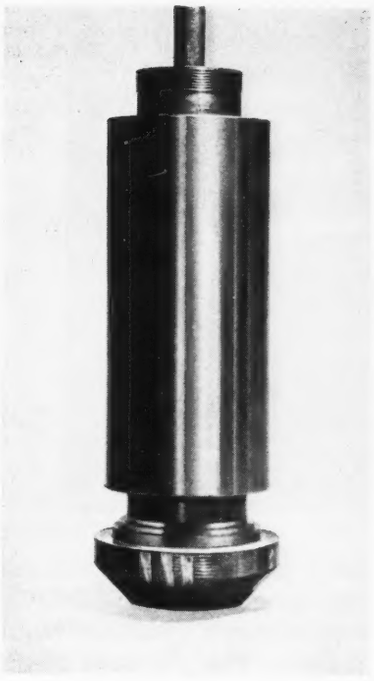


Fig. 6. Conforming anode made to suit the general contour of the recoilless rifle breech seen in Fig. 5

Another example of this work may be seen in Fig. 4 where a cast-aluminum saw table is illustrated. Here, the top surface and the edges of the guide slots were chromium-plated to provide a hard, smooth surface that would not be scratched or marked as the wood moves over it.

Generally, the most important consideration in chromium-plating is to avoid building up the deposit on edges and corners and to obtain a uniform and even distribution of plating on all surfaces. As previously mentioned, this is accomplished by using anodes that conform to the general contour of the work. Because of the low throwing power of chromium, this is especially important in plating recesses and holes. A typical application is shown in Figs. 5, 6, and 7. The alloy steel part, Fig. 5, is the breech of a 57-millimeter recoilless rifle. The surfaces to be plated, as seen at the right in Fig. 5, consist of the top and side of the internal flange under the lugs. No build-up at the corners and edges was permissible, and a plating thickness of 0.004 inch, uniform within 0.0002 inch, was required. The part at the left of the illustration is shown provided with a protective grease coating—the condition in which the breeches are received prior to plating.

Conforming anodes, one of which may be seen in Fig. 6, were made for application to the work in the manner shown in Fig. 7. The breeches were placed over the anodes after wet-blasting and masking the areas that were not to be plated with a cellulose-acetate plastic coating. A special plating rack, Fig. 8, was built to handle four breeches at one time. The drive shown at the top of this rack provides a mechanical means of agitating the work. This eliminates the raising of impurities in the bath, which occurs when the solution is agitated by air pressure or paddling.

The speed of work agitation is a critical factor in the success of this operation, since it is instrumental in speeding the electrolytic action by maintaining the chromium content of the solution in the area immediately next to the work. Using a special high-speed solution and a current of 100 amperes, 0.004 inch of chromium is plated on the gun breeches in 1 1/4 hours. Since chromium is non-magnetic and has very low insulating properties at thin sections, a magnetic gage, accurate within 0.00001 inch, is employed to check the thickness of the coating.

Another application of the use of conforming anodes is illustrated in Fig. 9. Here a steel draw-

Fig. 7. Placing a breech over a conforming anode. Internal areas that are not to be chromium-plated are masked with a cellulose-acetate plastic coating

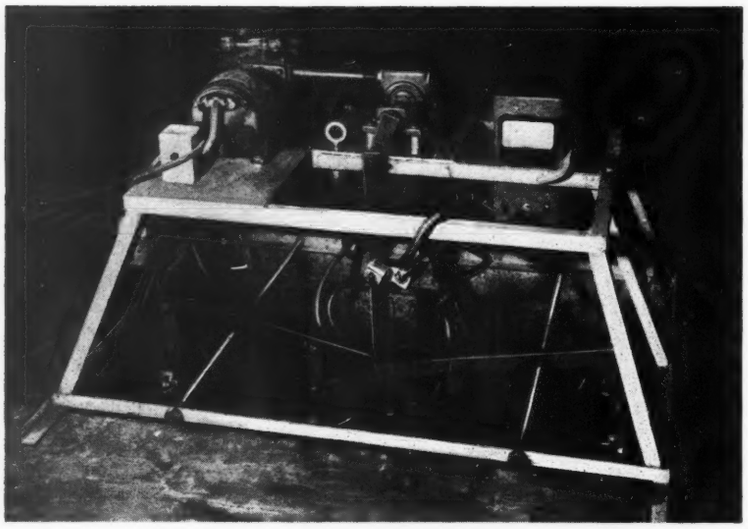


Fig. 8. Special plating rack for coating four rifle breeches simultaneously. A mechanical drive agitates the work to speed the electrolytic action

ing die is shown being removed from a plating tank. A circular anode surrounds the bore and covers part of the face, the total area to be plated being approximately 70 square inches. The deposition rate, with another special solution, is 0.003 inch per hour. A thickness of 0.001 inch is plated on the die bore and face, using 5 amperes of current per square inch.

Other parts that required careful analysis before chromium-plating include a complete aluminum pistol, the aluminum sole of a flat iron, bearing balls, aluminum car window trim, aluminum fishing reels, and silver contact points. Some of the contact points are copper, with a 0.010 inch thick plating of silver over which a flash plate of chromium, 0.0001 inch thick, is applied. The chromium eliminates the danger of arc burning of the contacts, and at the same time, maintains the high degree of conductivity characteristic of silver. Although wet-blasting was not required in this work, it was essential to have absolutely clean surfaces.

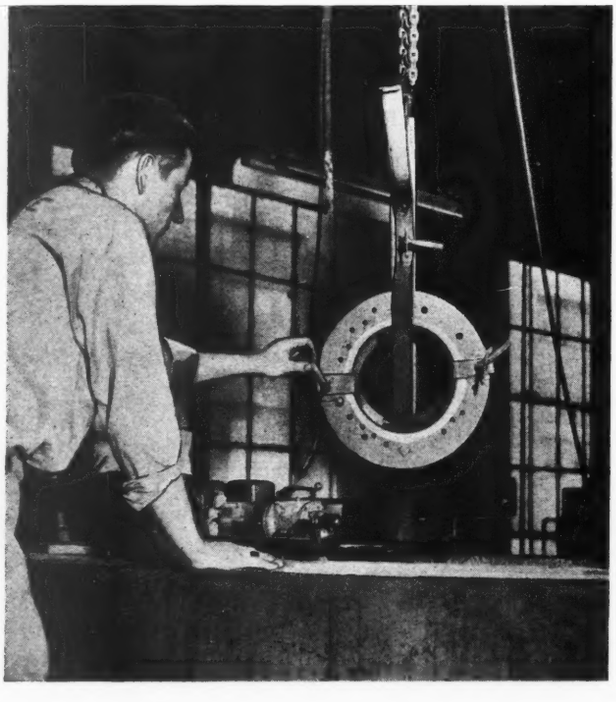


Fig. 9. An anode surrounds the bore and covers part of the face of this drawing die, which is chromium-plated to a thickness of 0.001 inch

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Mechanical Engineering Summer Courses at the Massachusetts Institute of Technology

New developments in five phases of mechanical engineering are to be emphasized in special courses to be given this summer at the Massachusetts Institute of Technology. The courses are on metal-cutting, internal combustion engines, lubrication engineering, vibration, and industrial photoelasticity, with special attention to machine design and manufacturing methods based on the latest information derived from research and industrial practice.

The dates for the courses are: May 26 to June 6, Metal-Cutting; June 9 to 23, Internal Combustion Engines; June 23 to July 3, Lubrication Engineering; August 4 to 15, Vibration; and August 18 to 30, Industrial Photoelasticity. Further information can be obtained from Dr. Ernest H. Huntress, Director of the Summer Session, Room 3-107, Massachusetts Institute of Technology, Cambridge 39, Mass.

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According to statistics compiled by the Automobile Manufacturers Association, 66.5 per cent of all households in the United States own automobiles, while 70.6 per cent of farm households own one or more automobiles.

Brazing the Modern Way

By LESTER F. SPENCER

BRAZING often simplifies the joining of similar or dissimilar metals, so that production costs are considerably reduced. The conditions under which brazing can be done depend, to some extent, on the base metal to be joined. In general, the six fundamental factors in producing a satisfactory brazed joint are good fit and sufficient clearance; cleanliness of base metal; proper fluxing; assembling and supporting of parts to be brazed; heating and flowing of brazing alloy; and removal of residue after the brazing operation.

A definite relationship has been proved to exist between the strength of a brazed joint and the clearance provided. For silver brazing, a clearance of 0.0015 inch is preferred. The clearance factor may be changed slightly in brazing various kinds of metals and different types of joints. However, the minimum clearance for any specific job usually offers the greatest strength in the brazed joint and maximum economy in the use of the brazing alloy.

Cleaning of the parts to be brazed includes the removal of oils and greases by a suitable degreasing solvent and the removal of oxide formations by pickling agents, grinding, or shot-blasting. Sand-blasting is not usually recommended due to the fact that minute particles of silica become embedded in the work surface, which are apt to nullify the wetting action of the brazing medium.

Of equal importance to cleaning work preparatory to brazing is the maintenance of a clean surface during the brazing operation. This can be accomplished throughout the heating cycle by the use of a reducing atmosphere in the brazing furnace, immersion of the work surfaces in a protecting medium such as salt, or utilization of a fluxing agent. The degree of protection necessary depends on the composition of the material being brazed and the extent to which oxides form on it during the heating cycle.

The method of assembling and supporting the component parts of an assembly is an individual problem. It is advisable to avoid the use of extensive fixture arrangements in furnace brazing, since they limit production quantities. Instead, such aids as spot-welds, press fits, staked fits, swaged parts, crimping, spinning, and pins can be employed. Fixtures, however, are usually necessary in brazing assemblies by torch, induction heating, etc., as shown in Fig. 1. Where such localized methods of heating are employed, production requirements are generally low.

The heating medium used for a particular brazing operation is the prime factor in determining the time and cost of the operation. A wide choice of heating methods is available, including gas torches; gas and air burners; electric induction; oil, gas, or electric furnaces; electric resistance; incandescent carbon; and molten salt or alloy baths. The method utilized will depend upon such factors as quantity requirements,

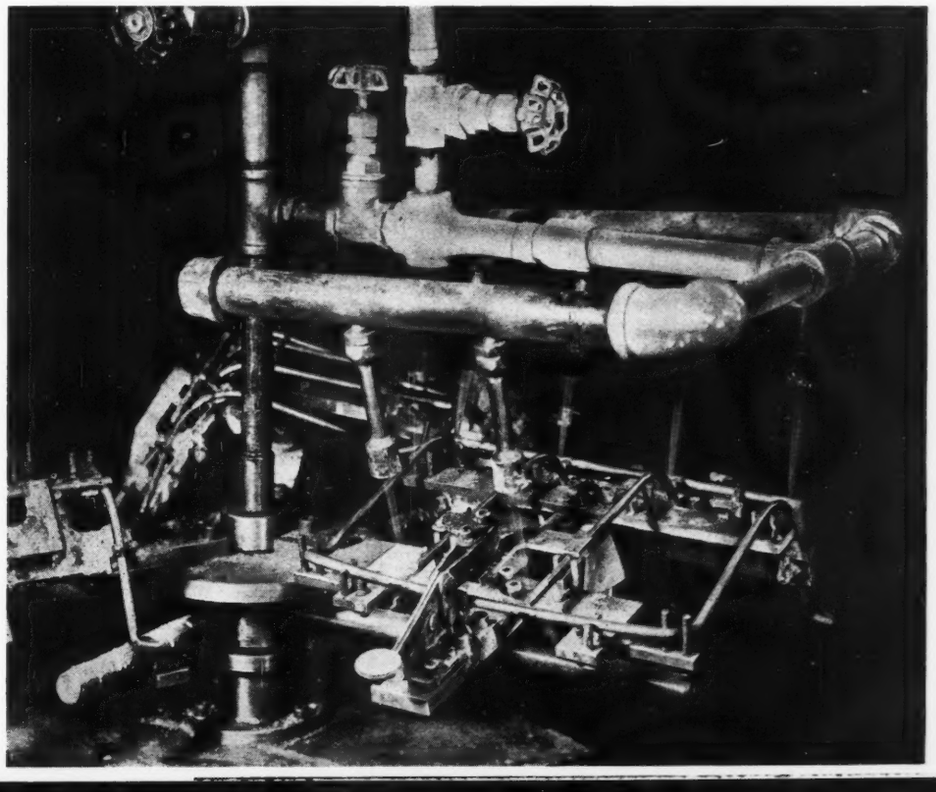

Fig. 1. The use of jigs on a turntable speeds the brazing of steel racks with fixed gas-air burners

size and shape of parts, kind of work to be performed—whether in the field or shop—heating equipment available, etc.

Gas torches are widely used because of their versatility and low initial cost, although this method of heating is slow when the torches are manually operated, and requires experienced help. A number of different types of fuels are employed in torches, the oxy-acetylene combination providing the hottest flame, fast heating, and flexibility. Multi-flame tips make it easy to heat uniformly. These gas-air burners are flexible in that combinations of fixed burners can be employed for brazing large or small parts, of regular or irregular shape, as seen in the illustration. They lend themselves readily to mass production when used in conjunction with mechanical devices for the quick handling of parts and automatic control of the heating cycle.

The induction method provides a rapid, localized heating of the parts, eliminating to a large degree both distortion and the need for excessive annealing of adjacent areas. High production rates are possible where the parts are assembled in multi-position fixtures, with pre-placed brazing alloys. In addition, heating by this method can be automatically timed. Heating in gas, oil, or electric furnaces is fast and economical for small or medium-sized parts where assemblies are comparatively uniform in size. Pre-placed brazing alloys are utilized in this method, and a reducing atmosphere is provided in the furnace to eliminate undesirable surface reactions during brazing. Continuous production can be obtained by using conveyor type furnaces; where the work is large, batch type furnaces are employed.

In the electrical resistance method of heating, brazing is accomplished by passing a high current between two electrodes and through the parts to be joined. In some cases, the electrodes act as resistors, and, in others, the parts themselves offer the resistance. This method is well adapted to the brazing of small lap joints, and is used extensively in the manufacture of electrical apparatus. The brazing equipment often consists of converted spot-welders, in which either carbon or molybdenum electrodes replace standard copper electrodes and both current and pressure are reduced to just below the arcing point.

The incandescent carbon method of heating permits rapid heating of parts under pressure. The heat is easily controlled, and can be confined to small areas. Both stationary and portable units are available. In the former, the parts are assembled between electrodes, which press them together, eliminating the need for jigs. The brazing alloy is generally pre-placed.

The brazing block may be of carbon, graphite, copper-tungsten, or even steel. Both carbon and graphite blocks heat quite rapidly; however, they are not recommended where unit pressures exceed 200 pounds per square inch. When pressures exceed this value, copper-tungsten blocks are used. In this case, owing to the nature of the material, approximately twice the KVA capacity

Table 1. Composition of Commercial Brazing Alloys

Alloy Number	Chemical Composition, Per Cent						Flow Point, Degrees F.	Melting Point, Degrees F.
	Silver	Copper	Zinc	Cadmium	Phosphorus	Others		
1	5.0	58.0	37.0	....	....	....	1600	1575
2	7.0	85.0	....	....	....	Tin, 8.0	1805	1225
3	9.0	53.0	38.0	....	....	....	1565	1450
4	15.0	80.0	....	....	5.0	....	1300	1185
5	20.0	45.0	35.0	....	....	....	1500	1430
6	20.0	45.0	30.0	5.0	....	....	1500	1140
7	30.0	38.0	32.0	....	....	....	1410	1370
8	35.0	26.0	21.0	18.0	....	....	1295	1125
9	40.0	30.0	28.0	....	....	Nickel, 2.0	1435	1240
10	40.0	36.0	24.0	....	....	....	1445	1330
11	45.0	30.0	25.0	....	....	....	1370	1250
12	45.0	30.0	16.0	24.0	....	....	1145	1125
13	50.0	15.0	16.5	18.0	....	....	1175	1160
14	50.0	15.5	15.5	16.0	....	Nickel, 3.0	1270	1195
15	50.0	34.0	16.0	....	....	....	1425	1275
16	60.0	25.0	15.0	....	....	....	1325	1260
17	60.0	30.0	....	....	....	Tin, 10.0	1325	1095
18	65.0	28.0	....	....	....	Nickel, 2.0 Mang., 5.0	1445	1385
19	65.0	20.0	15.0	....	....	....	1325	1280
20	70.0	20.0	10.0	....	....	....	1390	1335
21	72.0	28.0	....	....	....	....	1435	1435
22	75.0	22.0	3.0	....	....	....	1450	1365
23	75.0	20.0	5.0	....	....	....	1425	1350
24	75.0	....	25.0	....	....	....	1345	1300
25	80.0	16.0	4.0	....	....	....	1490	1360

is required to braze the same unit area, as compared with graphite blocks.

Portable units, with tong-like jaws serving as electrodes, are widely used in joining taps to transformer windings.

Dip-heating is done in either a molten brazing alloy or a salt bath; the latter provides a fast, uniform heat, with easily controlled temperatures, and the parts are protected from the oxidizing effect of the air. The work is usually supported in jigs, with the brazing alloy pre-placed. This method is well adapted for parts of irregular shape.

Brazing Alloys and Fluxes for Various Metals

A variety of brazing alloys is available, among which the more common are copper, silver, brass, and silver-bearing alloys. A typical list of commercial brazing alloys (made by Handy & Harman) is given in Table 1.

Copper is generally employed in brazing steel to steel due to its free flowing characteristics and the fact that it can be used without fluxes. Its use is limited when certain metallic oxides hamper the flow of the brazing alloy. For example, in the furnace brazing of steel assemblies, less than 1 per cent total of the oxides of vanadium, silicon, chromium, aluminum, and manganese will cause trouble, and more than 2 per cent may require the use of a fluxing agent or a special furnace with a pure dry hydrogen atmosphere.

Brass is used to some extent as a brazing material, but it is necessary to add a flux to obtain free flowing characteristics. The varying melting points of brass, caused by the distillation and loss of zinc at different brazing furnace temperatures, may prove troublesome.

The silver brazing alloys are widely used in joining stainless steels; high-nickel alloys, such as Inconel and Monel; and non-ferrous alloys, such as brass, bronze, and copper. Silver brazing requires the action of a flux in order to obtain a satisfactory joint.

Eutectic silver brazing alloys—those with a narrow melting range—do not separate from the base material under heat, nor do they leave a residue on slow heating. They are especially applicable when the alloy is to be preplaced in the joint. Alloys with a wider melting range are preferred when clearances are large and it is desired to have a fillet or bridge at the joint. Either of these classes of alloys can be used when joints are to be preheated and the alloy is to be applied by hand. Both classes can also be used wherever separation from the base material can be prevented, or is inconsequential. It may prove more economical, however, to use an alloy with a lower silver content and a wider melting range, provided the flow point temperature is not objectionably high.

Both zinc and cadmium are used with copper and silver to produce brazing alloys. These alloys have low melting temperatures and the ability to flow and form a bond with most of the commercial ferrous and non-ferrous metals, except aluminum alloys and those having a very low melting point. Nickel is added to the silver brazing alloy to provide additional wettability, and is particularly suited for brazing such refractory materials as Stellite, cemented carbides, and other high-tungsten alloys.

For higher temperature applications, manganese is added to the brazing alloy to promote both wetting and bonding. When zinc and cadmium are objectionable because of their volatility, tin is often substituted (see alloys Nos. 2 and 17, Table 1). These two alloys are suitable for gas-atmosphere brazing without a flux. Zinc is preferred to tin as an alloy addition due to its better wetting properties; however, in certain cases, it is necessary to use the tin-copper-silver alloys.

Many different fluxing materials are available, and the particular one to be used for a specific job is best determined by experimentation. Basically, a flux should react with, and reduce or dissolve, any oxides or contaminants normally present on metallic surfaces; it should protect the clean surface from further contamination during brazing; it should not unduly attack the metal itself; and it should be sufficiently easy to remove from working surfaces to permit intimate contact between the metals being joined.

In brazing steels where copper or brass is used as the brazing alloy, anhydrous borax or a mixture of anhydrous borax and boric acid can be used as the flux. The glass-hard residue that remains after brazing is usually removable either by stiff wire brushing or chipping. Cryolite is also used as a fluxing material, forming a deposit that is mildly corrosive upon exposure to air. This flux is readily removed from the brazed parts either by cleaning in steam or immersing in hot water. The alkali bifluorides, in combination with borax or boric acid, are used as fluxes in the brazing of metals that have refractory oxides. These include stainless steels, aluminum bronzes, silicon bronzes, and beryllium copper. The potassium salts are more effective than the sodium salts, and by varying the proportions, a wide variety of fluxes can be produced that will satisfy almost any brazing condition.

A second article, to appear in May MACHINERY, will describe various methods of brazing these materials.

Functional Gear Checking

By FRED BOHLE
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Illinois Tool Works, Chicago, Ill.

THE primary purpose of gear inspection is assurance of a certain standard of accuracy and quality. In addition, gear checking serves to control gear manufacturing processes in the most economical way. Basically, there are two distinct types of gear checking—functional and analytical. The first consists of testing gears by the way they roll or function; the second comprises various methods of checking the dimensional characteristics of a gear such as the involute, spacing, or lead.

In the development of modern gear checking practice, testing by the way gears roll or function came first. Today, in the most up-to-date gear departments, rolling fixtures and machines that produce gear charts are still the "policemen" of the process. Simple rolling fixtures, using master gears and indicators, are placed among the hobbing, shaping, and shaving machines to constantly check the output of these machines. Fixtures of this kind, sometimes combined with recording devices, are also found in the final inspection department. A rolling fixture, such as described, is shown in Fig. 1.

The question of whether or not to check a gear is directly tied in with the ultimate performance requirements of that gear. Within certain wide limits, the performance of modern hobbing and shaping machines, together with their generating tools, is reliable. The gears turned out by these machines are usually within accuracy requirements, and need not be checked, except, possibly, for size.

Gears that are expected to give long, continuous service, run quietly, and transmit heavy loads, must be checked, because it is accuracy that makes such performance possible. Uncontrolled output of gear generators does not produce gears of sufficient quality. To put it differently, if the required accuracy of a gear is such that to obtain it would necessitate the use of true running, precisely sharpened hobs and true running work-arbors, the gear itself should be carefully checked. This is because

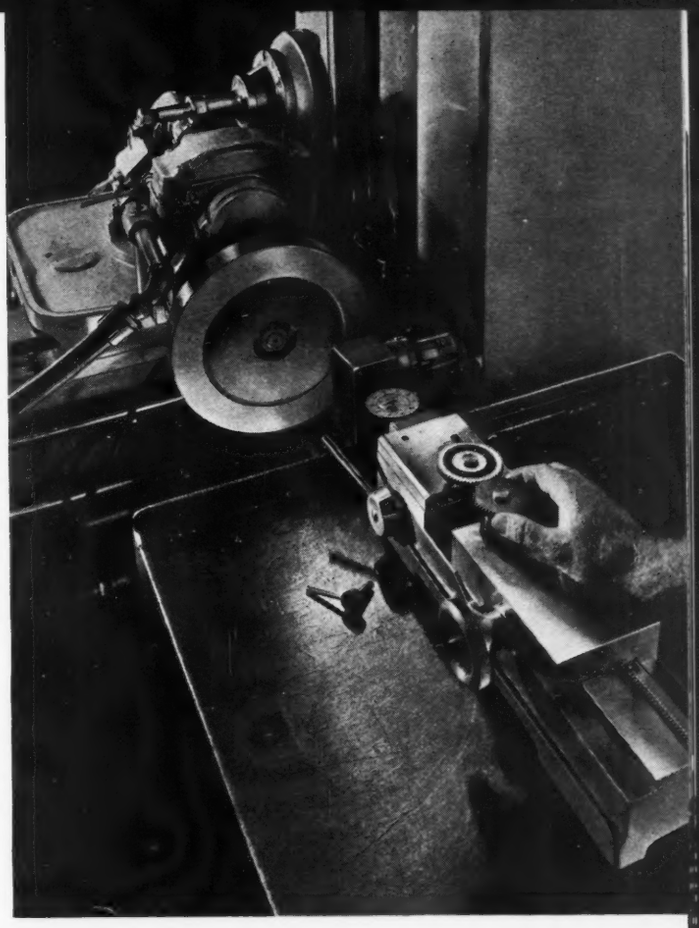


Fig. 1. Gear rolling fixture placed beside hobbing machine for convenient functional checking

some of the imperfections that occur in gear manufacture are additive. For instance, side wobble, distortion due to heat-treating, and run-out of the work-arbor may all combine to produce an unacceptable gear. The same is true of a hob, in which a slight lead error may be intensified by poor sharpening and further aggravated by run-out of the hob-spindle.

It is universally recognized that accuracy of the holes in gear blanks is of major importance in controlling run-out. Frequently overlooked, however, is the fact that side wobble is also highly important. Actually, it is somewhat difficult to differentiate between the two—side wobble is just another form of run-out. In practice, the run-out of gear blanks is some combination of the three types shown in Fig. 2.

Inaccuracies in the various spindles, arbors, and gears of hobbing and shaping machines have a certain effect upon the gears produced. To them must be added any inaccuracies in the generating tools—those that are inherent in the tool as well as those that have been induced by improper sharpening and mounting. Other gear errors are the result of deflection of arbors and shafts under the strain of cutting, distortion in heat-treatment, and dirt and chips on the locating surfaces. This list of possible causes of inaccuracies in gears is by no means complete, but enough have been mentioned to indicate the amount of control that must be exercised to produce fairly accurate gears.

In theory, it might be possible to control the quality of gears by constantly checking all parts of the machines, tools, gear blanks, and arbors capable of causing error, and making suitable corrections. But in practice, this would not be expedient. It is far more economical to check the gears and trace any excessive errors back to their source. This is facilitated by functional gear checking.

Inspecting all the details of a gear involves a series of checks for size, lead, straightness, involute, spacing, and run-out. A few gears—master gears for instance—are actually checked in this way. However, even the checking of master gears cannot truly be called 100 per cent inspection. Gears usually have many teeth, and to repeat the helical lead and involute check on every tooth would impose a considerable burden. Therefore, master gears are checked for size, run-out, and spacing all around. They are fur-

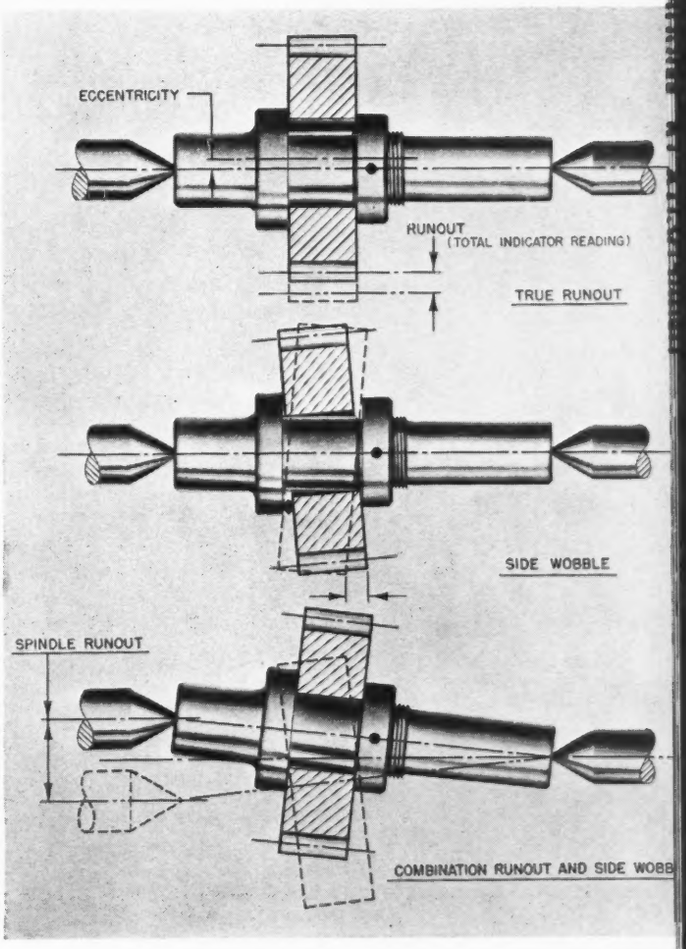


Fig. 2. Diagrams illustrating types of run-out that occur with helical or spur gears

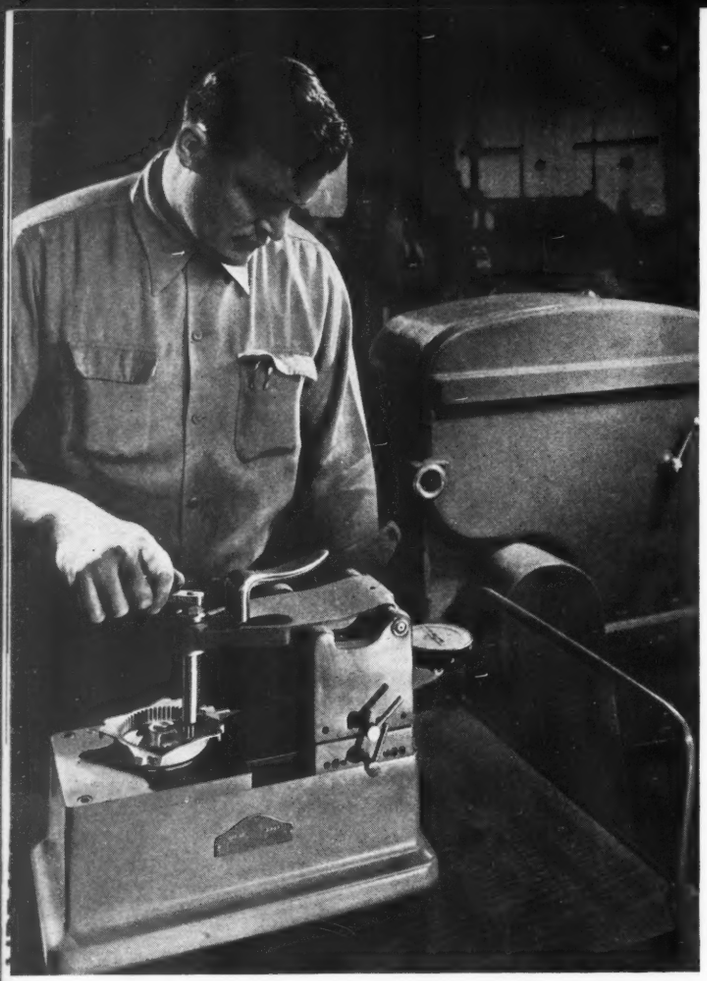


Fig. 3. Gear rolling fixture designed for the functional inspection of internal spur and helical gears

ther checked for lead and involute on a few scattered teeth, it being assumed that all other teeth will be alike. If true 100 per cent inspection is neither economical nor necessary on master gears, it is certainly not warranted in the case of production gears, even though they may carry a "precision" label.

Gears are meant to transmit loads at constant angular velocities. The more constant the velocity, the smoother the transmission and the better the gears. Theoretically constant angular velocity is the result of perfect involutes, tooth spacing, and helical leads. Unfortunately, there are no perfect involutes and tooth spacing and, if there were, they would become imperfect due to deflections under load. Nevertheless, comparatively smooth rotation is the main criterion of gear quality. Since this can be achieved only by relatively true running gears with good involutes and spacing, it is justifiable to check the smoothness of gear rotation without going into all the details of run-out, spacing, and involute. This means checking a gear by the way it functions.

In functional gear checking, the gear is rotated with a master of known accuracy in intimate metal-to-metal contact. If involute, tooth spacing, helical lead, and run-out were perfect in both the master and the gear, the two would roll together with no variations in center distance. However, if errors are present in any one of the elements, the size and run-out of the gear will be reflected at their true values, while inaccuracies in involute, tooth spacing, and helical lead will show up on the indicator or chart in a distorted but magnified ratio, depending upon the pressure angle. The diagram in Fig. 4 indicates fluctuations in center distance due to involute errors.

Admittedly, a rolling check is not truly functional because gears do not roll in metal-to-metal contact in operation. With the exception of some instrument gears, all gears are made with backlash, rotate at a fixed center distance, and contact only on the driving side of the teeth. Furthermore, a true functional check should reveal errors as the result of variations in angular velocity.

Such a check can actually be made by an arrangement similar to that shown in Fig. 5. This set-up permits tests to be performed on gears under full load, partial load, or idling, and can be used for checking the combined effect of all errors, tooth deflections, and intentional profile

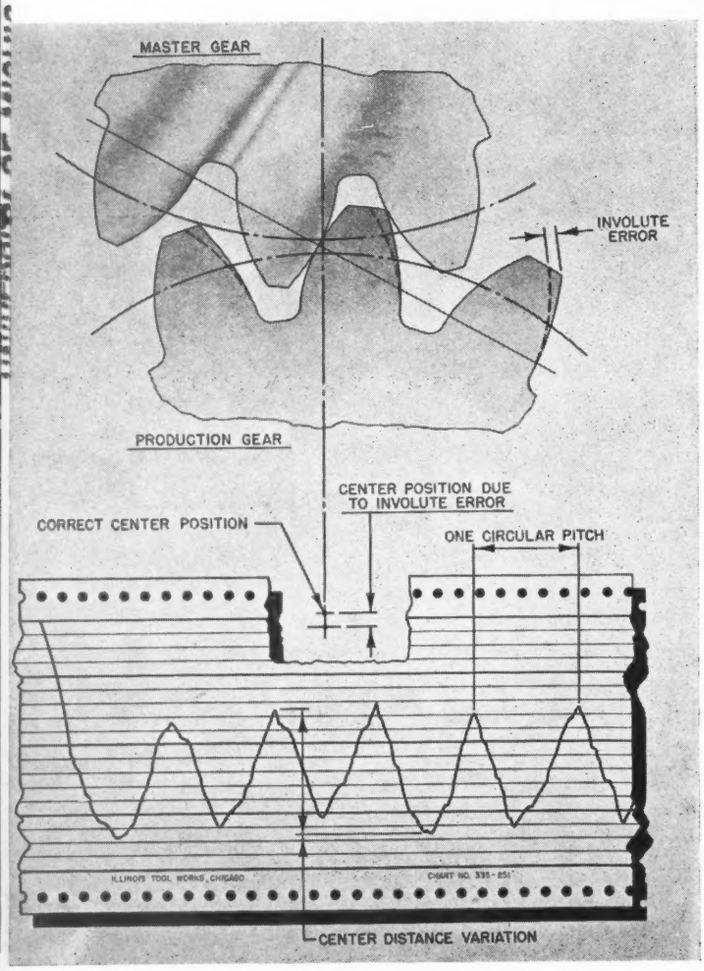


Fig. 4. Diagram that shows how center-distance fluctuations due to involute error are recorded on a chart

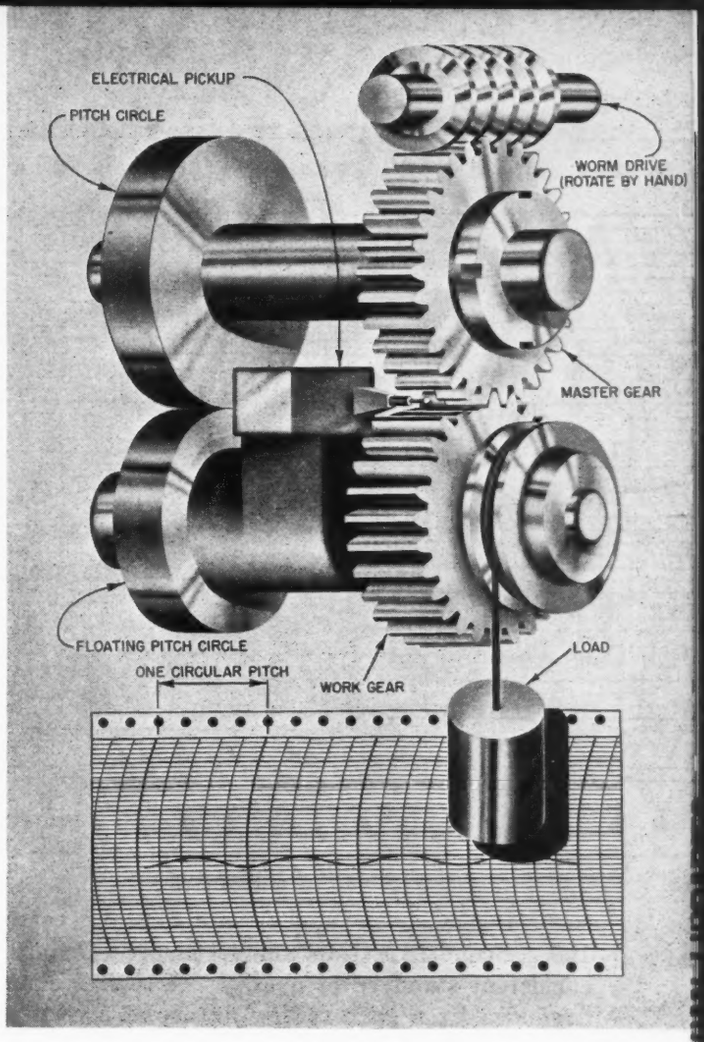


Fig. 5. Arrangement for making an angular velocity test under load, and chart produced in this inspection

modifications as they affect the rotation of two gears.

The check is reliable for a partial rotation of, say, 90 degrees. Beyond that point run-out conditions between the gears and pitch circles cause a drifting of the pattern, which need not be a reflection on the gears. However, this kind of functional check does not indicate pitch diameter size and run-out as clearly as metal-to-metal rolling does. Furthermore, it is not as simple, handy, or easy to operate as a rolling fixture. It is strictly a laboratory method, of interest only to manufacturers who want to check deeply into the behavior of gears.

While the rolling check is not a true functional check, it is the closest and most economical approach to it. The measured variations in center distance may not be exactly proportional to the variations in angular velocity, but they give an indication of the quality of the gear. Although lacking in some respects, gear rolling gives a correct measurement of pitch diameter size and run-out.

Beyond that, the rolling check gives a distorted, but nevertheless indicative, picture of the combined errors of involute, spacing, and helical lead. If excessive, these errors should be analyzed on involute, lead, and space checking machines. Actually, this combination of functional and analytical checking has been found by industry

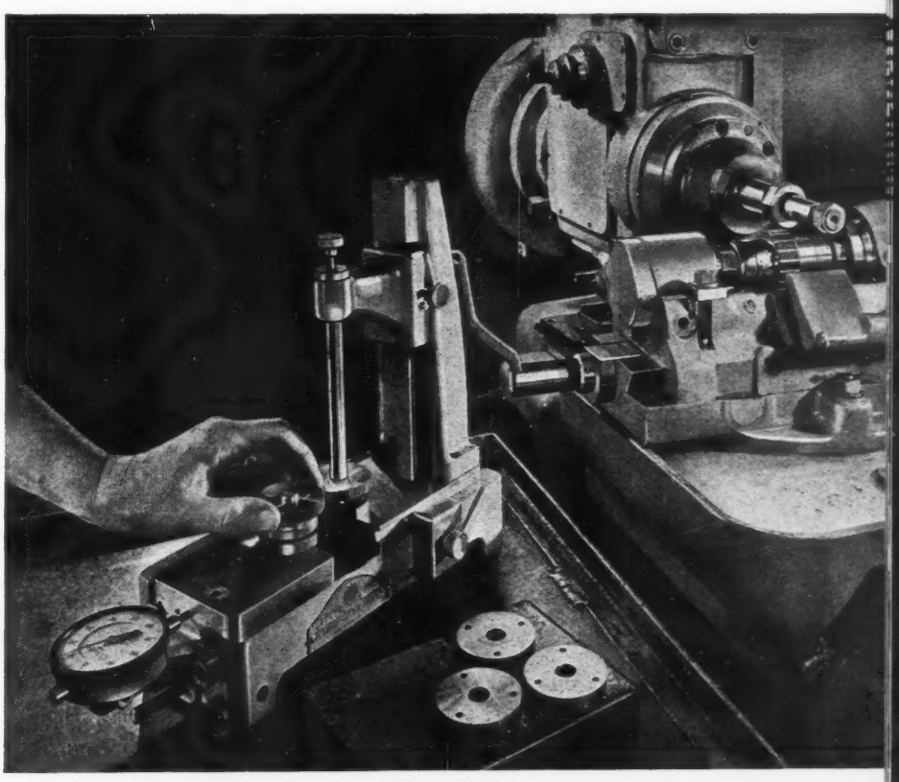


Fig. 6. Another production check made on a fixture located adjacent to a gear-hobbing machine, in which center-distance variations are shown by a dial indicator

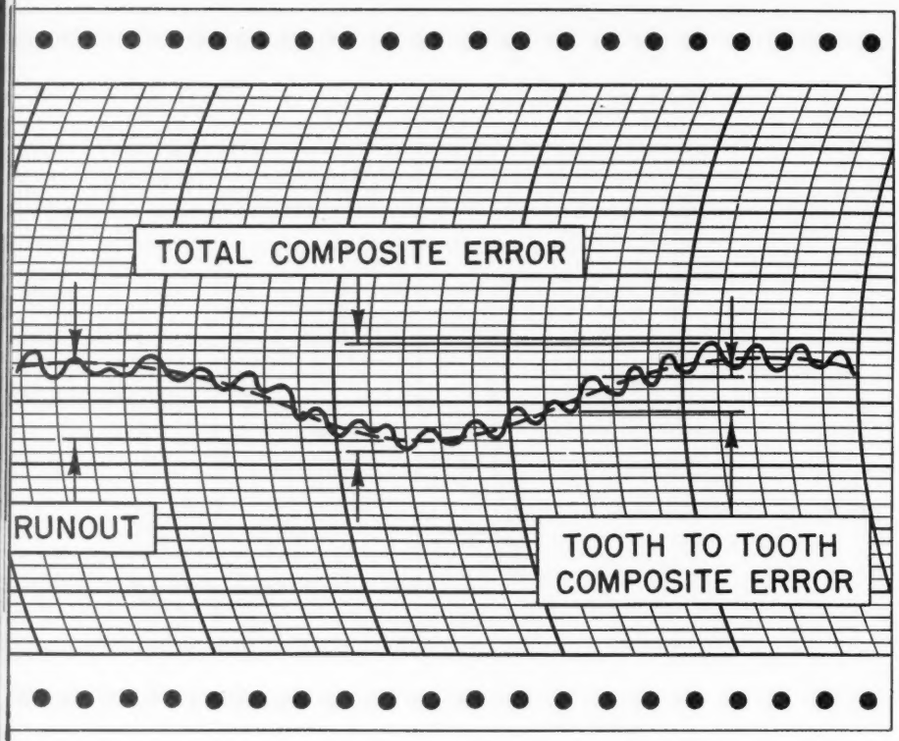


Fig. 7. Chart produced on a recording type of gear rolling inspection fixture, showing total composite error, tooth-to-tooth composite error, and run-out

to be the most economical way to avoid costly 100 per cent inspection, and yet insure a definite, consistent standard of quality. A typical chart produced by a gear rolling fixture is shown in Fig. 7.

Manufacturers of hobbing and shaping machines point out that true running tool- and work-spindles, and index worm-gears, more than anything else determine the accuracy of their machines. Makers of hobs claim that the amount of "weave" determines hob quality more than any other tolerance. "Weave" is the repetitive lead variation in every convolution of hob teeth, and is caused by run-out. Sharpening errors on hobs are not due so much to sudden spacing errors between flutes as to accumulations due to poor arbors or eccentricity in the headstock spindles and index-plates.

The problem of run-out occurs even with master gears whose tolerances for involute, spacing, and lead are small compared to those for run-out. Therefore, it is no exaggeration to say that the constant control of run-out in all phases of gear manufacture is the most important factor in determining the quality of gears.

Inaccurate holes in gear blanks, side wobble, run-out of work-spindles and checking arbors, eccentricity of index gears of hobbing and shaping machines—all do one thing, and that is, produce run-out in the gear. The same is true of run-out in a shaper cutter. All such run-out errors are readily detected by a gear rolling fixture because they are reflected in center-distance variation at their true value.

On the other hand, run-out in a hob or hob-spindle, faulty hob sharpening, and errors in the shape of the hob, shaper cutter, or shaving cut-

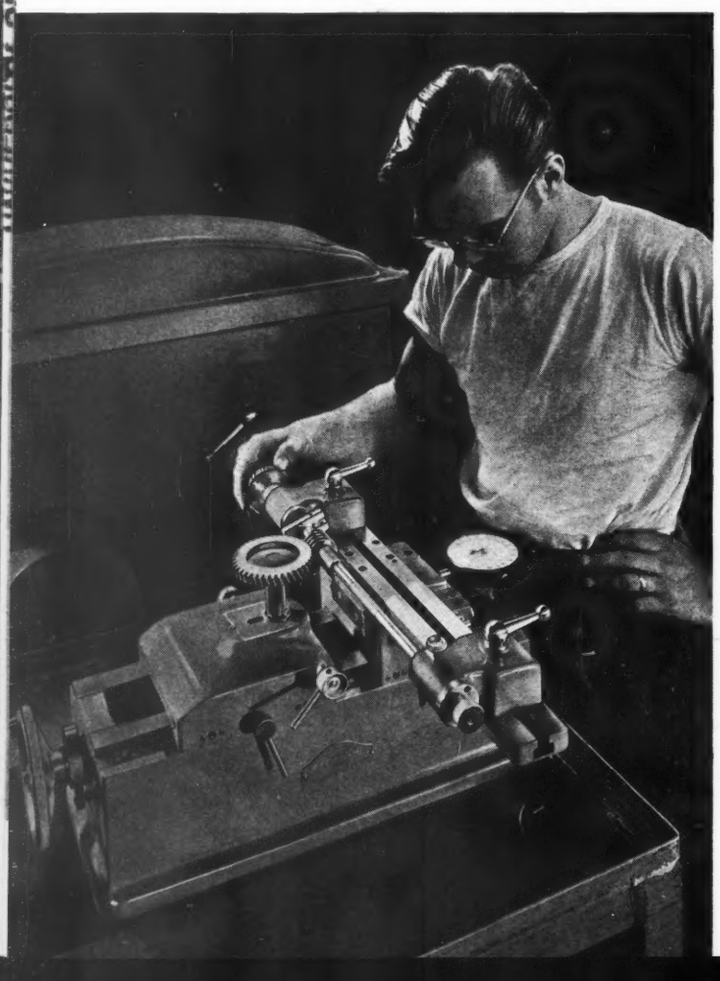


Fig. 8. Type of worm-gear rolling fixture suitable for determining run-out of worm-gears due to machine or work hole inaccuracies

ter teeth can only affect the shape of the individual gear teeth. Such errors will be indicated in a distorted or magnified ratio by a tooth-to-tooth flicker of the indicator needle or recording pen. Roughness of rolling indicates that the normal spacing of the gear teeth is not uniform for each degree of rotation, but it does not show whether only one side or both sides of the involute are responsible, or whether the inaccuracy is the fault of the involute or the spacing. As a rule, the tooth-to-tooth flicker is an indication of involute error that repeats itself with uniformity on every tooth.

Heat-treatment may affect both the shape and the concentricity of gear teeth. If functional gear checking is combined with the recording of errors, it becomes readily possible to separate tooth-to-tooth errors from those that affect the concentricity of the gear teeth. The tooth-to-tooth flicker, even though it represents composite errors, can be assigned a tolerance. Recording, therefore, permits an insight into the character of the errors that is not obtainable with plain indicators. Furthermore, recording makes it much easier to determine the effects of heat-treatment by comparing graphs made before and after heat-treatment.

The advantages of combining recording or graphic inspection with functional gear checking may be summarized as follows:

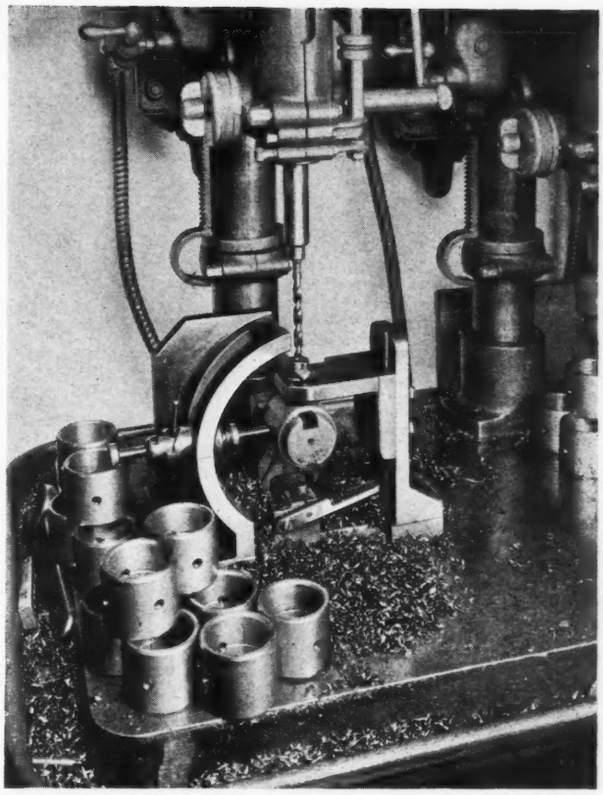
1. The charts give a breakdown between tooth-to-tooth errors and those of concentricity.
2. In distinguishing between these errors, charts furnish clues to their sources.
3. Charts are easy to read and provide permanent inspection records.

* * *

Training Manufacturing Personnel at the General Electric Co.

A new major training program designed to prepare young men for careers in manufacturing in the General Electric Co. is being established by the company. It consists of a three-year course, which will train men for supervisory, administrative, and technical positions, and will provide a sound understanding of basic manufacturing principles, along with knowledge of all phases of shop operation and related functions.

Candidates for the program will be selected from qualified college graduates in the fields of engineering, business administration, and the sciences, and also from within the company organization, including graduates of the G-E Apprentice Training Course. This is the fifth extensive training program that the company has founded.



Completely adjustable jig designed to facilitate drilling a large variety of work

Ingenious Drill Jig Handles Fifty-Seven Different Parts

An ingenious drill jig so designed that it can be easily and accurately adjusted for drilling equally spaced holes in fifty-seven different parts was recently developed by the Reed-Prentice Corporation, Worcester, Mass. The accompanying illustration shows this jig mounted on a Delta 17-inch drilling machine.

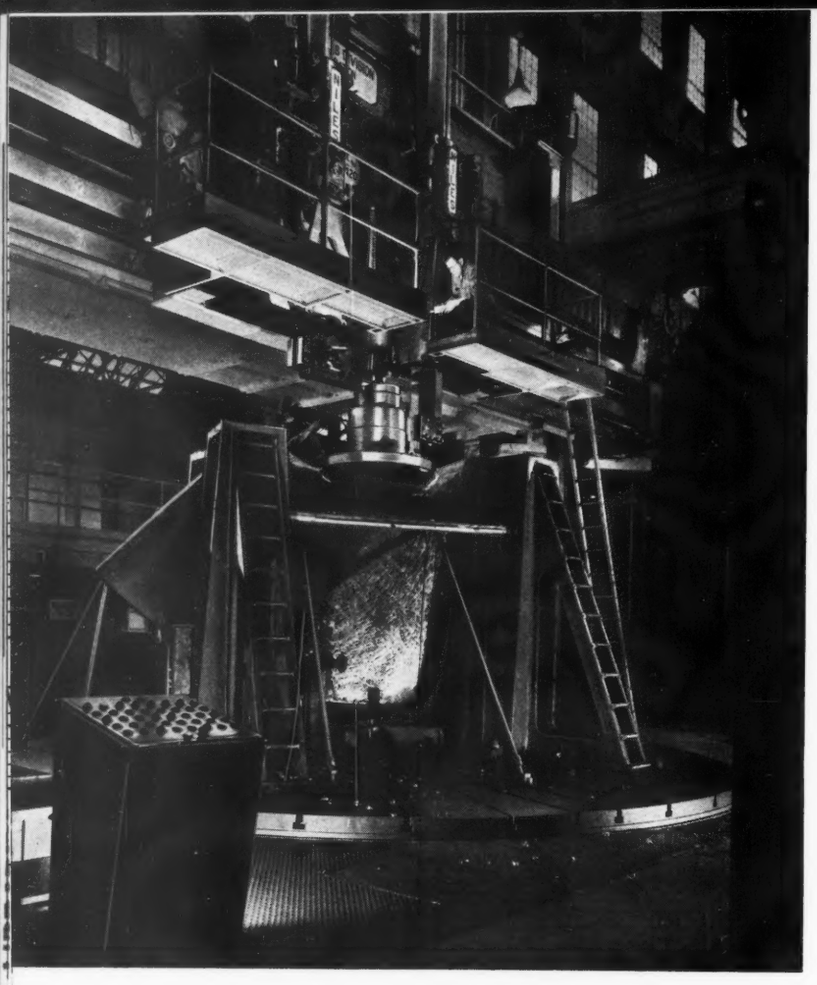
The jig is provided with an arbor-holding bracket in which the arbor can be adjusted horizontally or vertically to place the work in various positions. The drill bushing is mounted on a slide that can be moved vertically. A quadrant bracket is supplied with an indexing pin that is inserted in the first hole drilled in an operation to provide a means of accurately locating the work for drilling each succeeding hole.

* * *

The cause of chatter marks in grinding operations, according to *Grits and Grinds,* published by the Norton Co., is generally due to one or more of the following six conditions: Grinding cut too heavy; grinding wheel too hard; slender work unsupported by steadyrests; grinding wheel over-speeded; vibration transmitted to the machine from near-by sources; and vibration within the machine.

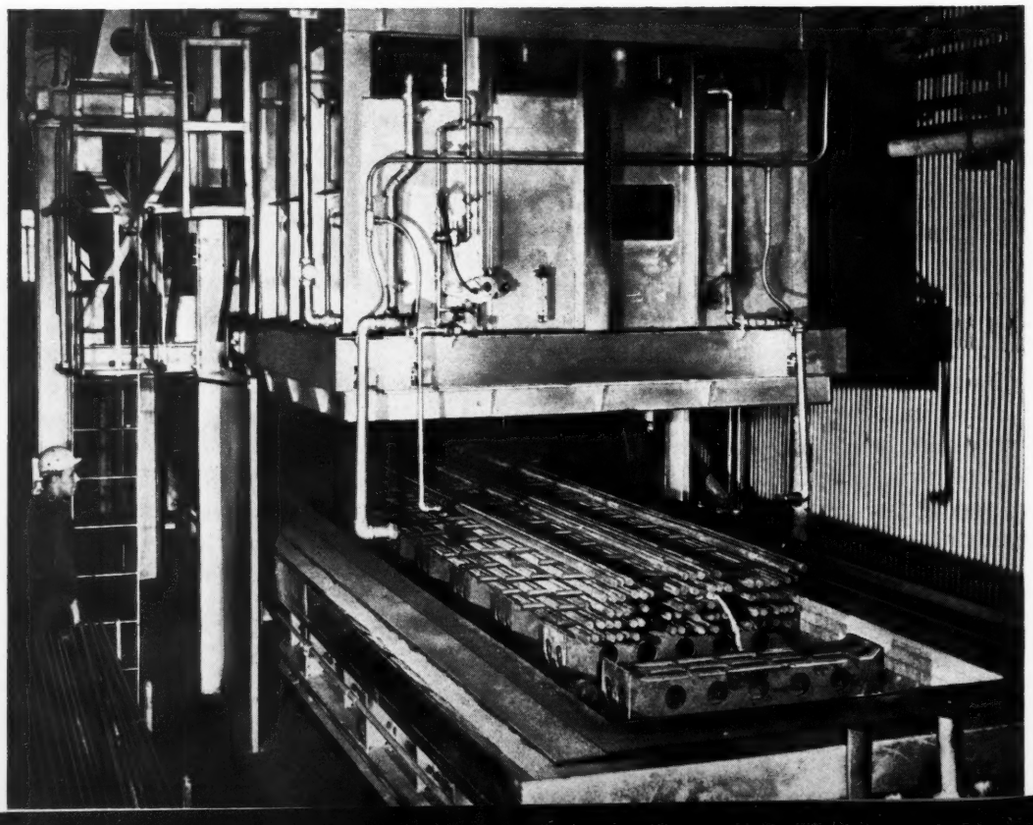
In Shops

Camera Highlights of Some Interesting Operations Performed in Various Metal-Working Plants throughout the Nation

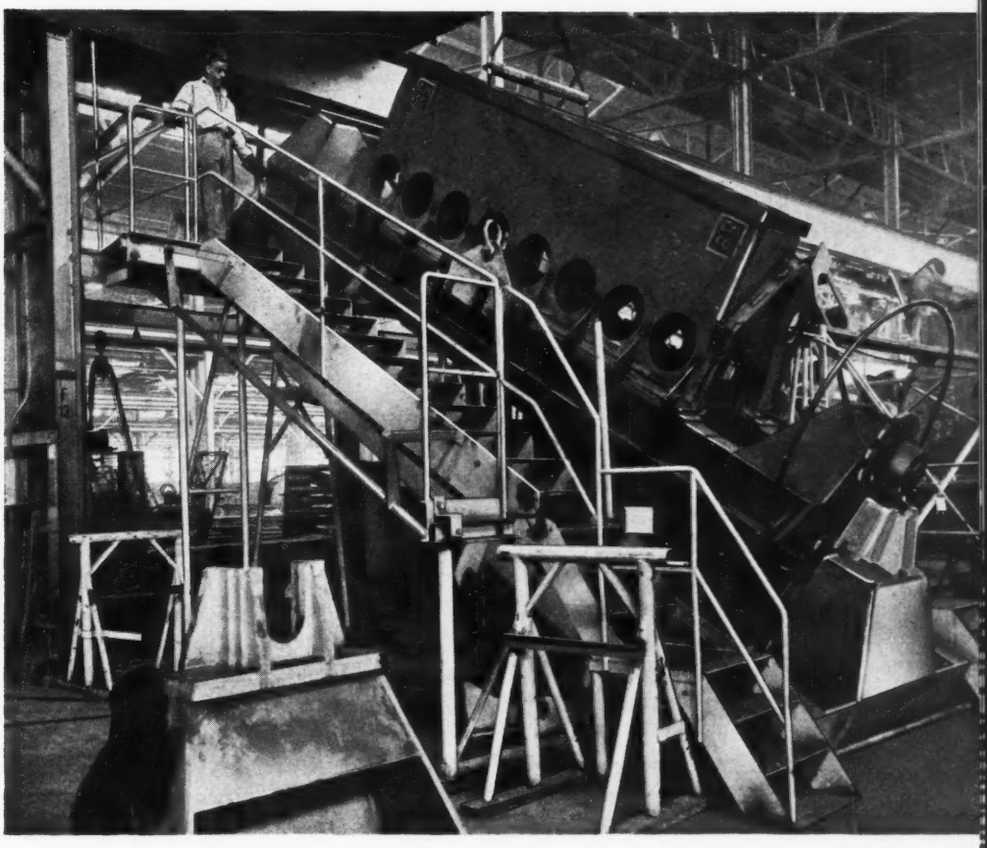


An adjustable-pitch runner vane for a 55,000-H.P. hydraulic turbine is machined on a 30-foot boring mill in the shops of the Allis-Chalmers Mfg. Co., Milwaukee, Wis. A lathe for this machining operation would be required to have a 20-foot swing and carry a weight of 14 tons on centers. Steadyrests would not be feasible. On the boring mill, the runner vane is supported by a center on the table and is held in vertical alignment by a tailstock on the rail

The car bottom of a controlled-atmosphere furnace in the Hazlewood cold-finishing department of the Jones & Laughlin Steel Corporation, Pittsburgh, Pa., is shown moving into place beneath the furnace cover, which has been raised. This furnace is used for carbon restoration, annealing, spheroidizing, and normalizing

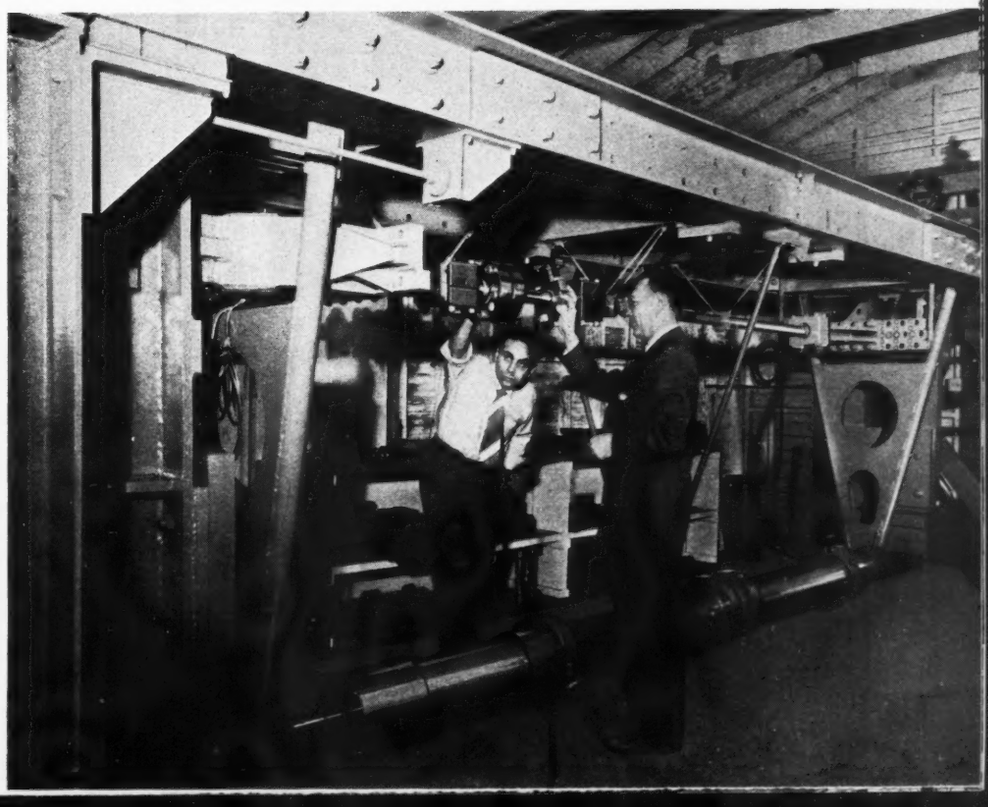


Around the Country



A welding fixture mounted on pedestals of different heights so that the work is tilted 45 degrees facilitates operations in the Philadelphia plant of the Baldwin - Lima - Hamilton Corporation. Two flights of stairs and a raised platform are provided for the convenience of the welders

Testing a plane part for strength with apparatus capable of pounding parts with a force of 500,000 pounds. Engineers of the Lockheed Aircraft Corporation use this equipment to check design safety factors by battering test parts for lengthy periods of time at loads that exceed the most extreme flight conditions



Unique Welding Fixture Results in Large Savings

A CHANGE in the design of an attachment bracket for a conveyor flight from cast and bolted construction to welded steel led to the development of a unique welding fixture. This simple change in design of the part reduced the cost of a flight at the plant of the Fairfield Engineering Co., Marion, Ohio, from 80 to 65 cents, and the welding fixture has permitted an increase in production to approximately one a minute.

Until the recent change, two cast brackets—one of which can be seen in the operator's hand in Fig. 1—were bolted to the conveyor flight and then riveted to a side chain bar which, in turn, was pinned to the moving chain. It was to simplify this job that the brackets were redesigned for welded steel construction.

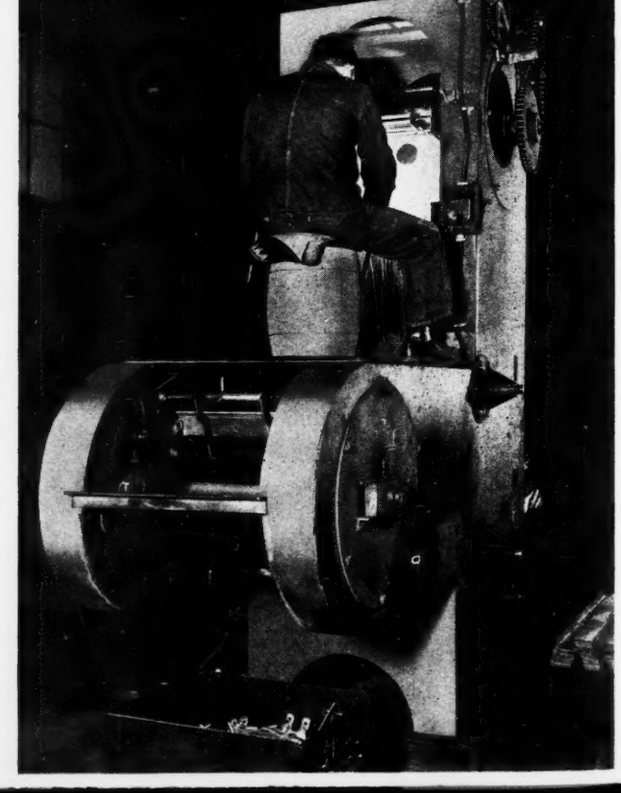
The brackets are now made on a punch press in a progressive die, which cuts to length and forms in one operation. The two brackets, two side chain bars, and a flight are placed in the power-driven conveyor type welding fixture, illustrated in Fig. 2, where they are welded into one integral unit.

The fixture was constructed of standard conveying parts made by the company. An operator at the floor level places parts on the continuously moving conveyor belt and welds a side chain bar to the flight on one side. The parts are then carried up to a second operator, sitting in back of the fixture at the top of the machine (Fig. 3), who welds the brackets and the chain bar on the opposite side. The completed flights continue to move downward and are dropped into a tote bin

Fig. 1. Previous bolted assembly of conveyor flight with cast bracket is shown in the operator's hand, while new steel attachment brackets and welded assembly are seen in place on the conveyor

Fig. 2. Conveyor flights are welded in this continuously moving fixture. An operator at the floor level puts parts in fixture and welds one side

Fig. 3. The moving fixture carries the parts up to another operator, seated in back of fixture, who welds brackets and side chain bars on opposite side



seen in the foreground. Welding is done with a Lincoln Fleetweld No. 7 electrode.

This welded assembly has eliminated the bolts and washers previously required, as well as the labor needed to produce four holes, bolt the attachment brackets to the flight, and rivet the unit to the side chain bar. About 26,000 castings per year have been eliminated. It is estimated that the change will save at least $2000 a year.

* * *

Measurement of Expansion of Aircraft Alloys at High Temperatures

Precision measurements of expansion at ultra-high temperatures, manifested by three alloys used in aircraft engines, are now matters of record. The findings were reported in a paper presented before the American Society for Metals at a meeting in Pittsburgh, by William P. Roe of the National Lead Co., and W. P. Fishel, professor of metallurgy, Vanderbilt University. The alloys under consideration were iron-titanium, iron-chromium, and iron-titanium-chromium.

Annealed samples were prepared for expansion or dilatation study by drilling holes in both ends of the ingots. The sample was placed in the bottom of a combustion tube, which was put in an upright resistance furnace. An alumel-chromel thermo-couple was inserted in each end of the sample and attached to a two-point "Micromax," which indicated the temperature first at one end of the sample and then at the other end in thirty-five-second intervals.

Extending from the top of the sample to the top of the combustion tube was a silicon-carbide push-rod on which rested a dial gage calibrated to 0.001 inch. During a test, the worker merely had to record dial gage readings and temperatures at thirty-five-second intervals.

* * *

Motion Picture on Steel Casting Manufacture

A color motion picture devoted to the manufacture of steel castings is attracting considerable attention throughout the foundry industry. This film, entitled "Steel with a Thousand Qualities," was sponsored by the Lebanon Steel Foundry, Lebanon, Pa. Based on a tour of the company's facilities, it shows the production sequence for carbon steel and alloy steel castings—from the blueprints to the completion of X-ray tests on a million-volt machine. There are fifty-five 16-millimeter prints and one 35-millimeter print available for free showings. The running time is thirty-seven minutes.

Exhibit Demonstrates Heat Stability and Other Properties of Silicones

An extensive exhibition to demonstrate the properties of silicones was recently held in New York City by the Dow Corning Corporation, Midland, Mich. Silicones, which are semi-inorganic materials with the ability to withstand both high and low temperatures, are being used for many industrial and military applications. They are available in a wide range of forms.

One of the demonstrations showed the heat stability and oxidation resistance of a pair of silicone-lubricated bearings set in blocks heated to a temperature of 300 degrees F. A bellows made of "Silastic," another silicone product, was shown to have heat stability and heat resistance by being continually flexed in a hot oil bath at 350 degrees F., with no apparent effect on its properties. The same material, when subjected to another test, displayed the ability to resist temperatures as low as minus 80 to 100 degrees. "Silastic" gaskets and O-rings are being used as seals for aircraft engines, automobile transmissions, and Diesel-electric locomotives.

Samples of metal pieces protected by silicone paints subjected to temperatures up to 1000 degrees F. had the same appearance as pieces that were not subjected to heat. Many other uses of silicones were demonstrated, including such applications as hydraulic fluids, electric insulators, mold lubricants, and water repellents. Durability of silicone products was shown by test pieces that demonstrated their resistance to oxidation and weathering. Waterproof and dielectric qualities were exhibited in electronic applications.

Exhibits like the one described are scheduled to be held in many of the principal cities throughout the country.

* * *

Calculator for Determining Pressure Required to Pierce Holes

A sliding-scale calculator for easily determining the required pressure, in tons, for piercing a given size hole in any thickness and type of metal has been devised by the Ward Machinery Co. Shifting of the sliding scale enables the pressure to be found for piercing holes ranging from 3/16 inch to 10 inches in diameter, and from 0.5 inch to 30 inches in periphery, in aluminum, zinc, brass, copper, carbon steel, and stainless steel.

Shops engaged in stamping work can obtain the device, without charge, by writing to the Ward Machinery Co., 564 W. Washington Blvd., Chicago 6, Ill.

Set-Ups that Expedite Camera

By HERBERT CHASE

MANUFACTURING of quality cameras on a production basis depends largely upon expert sheet-metal working; hence it is not surprising to find interesting and unusual set-ups for stamping and related operations in the Camera Works of the Eastman Kodak Co., Rochester, N. Y. The operations here described are, of course, only a few of many performed, as this plant produces a large range of still and motion picture camera models, each comprising many parts, besides making numerous accessories.

Among the unusual set-ups employed are those for making the two body sections, Fig. 1, for the Kodak Duaflex camera. When combined, these two parts form the four walls of a rectangular shell. Each part has two well rounded corners, and both edges are stiffened and given an attractive appearance by channel-like beads that extend around both corners of the formed components. As the result of the use of well designed dies and an unusual combination of two machines, these channel sections follow the radii without closing in or kinking at the bends; at the same time, rapid production is achieved.

Fabrication of the two halves starts on a Yoder cold roll-forming machine, Fig. 2, which produces the beads along the edges of aluminum coil stock 3.172 inches wide and 0.030 inch thick.

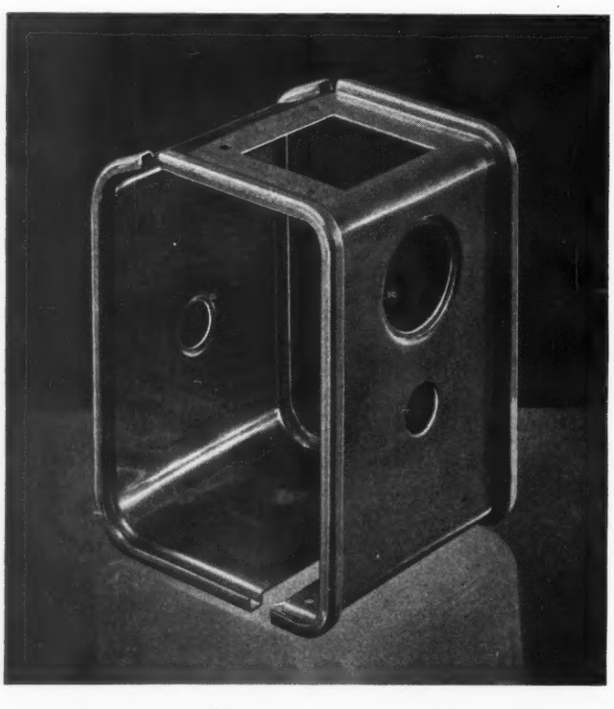


Fig. 1. Two half-sections, made from aluminum strip stock, form the four walls of a rectangular shell that serves as a camera body

The rolls on this machine straighten the stock and form the channel at each edge in a continuous operation. After passing from the rolls, the stock is fed through a flying cut-off attachment, seen at the right in Fig. 3, which severs the stock into 10-foot lengths. These lengths are fed onto a table at the left, where they are stacked in piles.

Lengths thus formed are then transferred to another table, seen at the left in Fig. 4, from which they are fed into the Struthers Wells combined press and tangent bending machine shown. In the first portion of this machine, there is a three-stage progressive die that pierces the small holes and larger openings required and embosses an offset around one opening. After these operations, the strip is advanced until it is sheared into work-pieces of the required length. The work-pieces are then fed into the die of the tangent bender.

Actually, there are three duplicate dies, in turret formation, on the tangent bender. One die is attached to each arm of a carrier that is pivoted about its center. The carrier is so actuated that it indexes automatically 120 degrees after each work-piece is bent. During the indexing, ejector-pins are moved radially outward by an eccentric at the center of the carrier, pushing the formed piece off the die, so that it drops into a chute, seen at the lower right, and slides down into a tote box. As one die is indexed to the ejecting position, another moves into the forming position, ready to receive the next work-piece when it is advanced from the progressive die.

Forming or bending in the die is done by wiper shoes. These shoes are lowered by the head of the machine, and wrap the preformed strip around the lower die. The work-piece is so confined between the die and the shoes that the channel-shaped beads cannot be drawn in at the bend. The sides of each channel are also restrained from kinking.

The action of this machine is completely automatic, except that the preformed strips must be started through the machine by hand. In so doing, the operator merely guides the 10-foot long strip on the table so that its lead end abuts

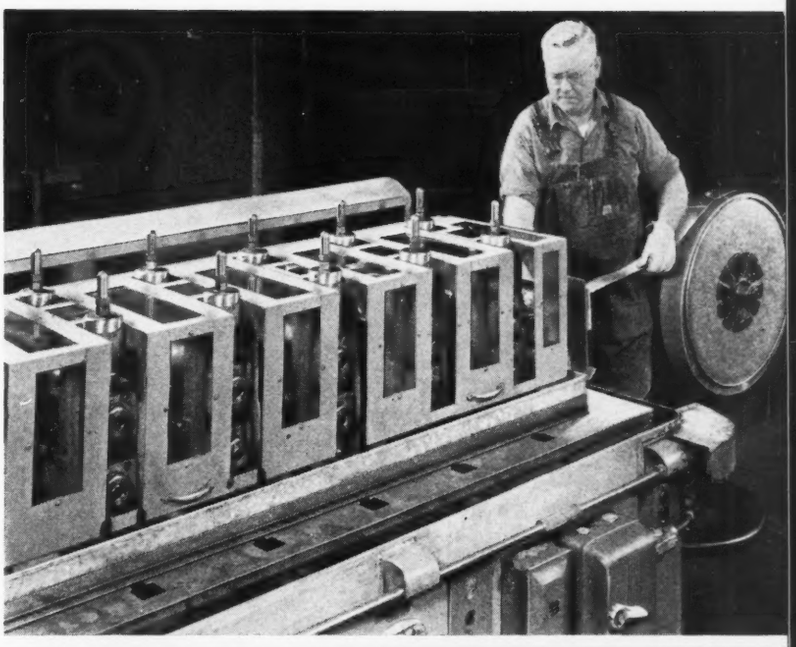
against the tail end of the previous piece until the new piece is picked up the automatic hitch feed. Once the strip is started, the progression is automatic, and the operator need only watch the machine until the next length has to be started through.

Operation of the machine, including the portion that reciprocates the progressive die, is hydraulic. Slugs pierced out in the die drop through the lower half into a tote pan. All moving parts are well enclosed, and the use of the three indexed bending dies, with their automatic ejection feature, avoids hand removal of finished pieces, thus safeguarding the operator.

A production rate of 750 pieces an hour is attained in this operation. Although the same preformed strip stock is used for each half, the two halves of the rectangular shell are not duplicates, and two different set-ups are required.

Some indication of the extent to which stampings enter into the fabrication of cameras can be had from Fig. 5, which shows a completed Kodak Brownie camera, several of the stampings used in its construction, and some nearly completed sub-assemblies. Most of the housing assembly is effected by projection welding. On several parts, the embossed projections can be seen, and on some assemblies, the welds are visible. However, the welds are so made that they can be detected only with difficulty, if at all, on finished exposed surfaces.

This result is attained largely by good design of the component parts and by the use of well made welding fixtures. One of the fixtures appears in Fig. 7, which shows the camera housing on a horn die, ready for the final welds. These



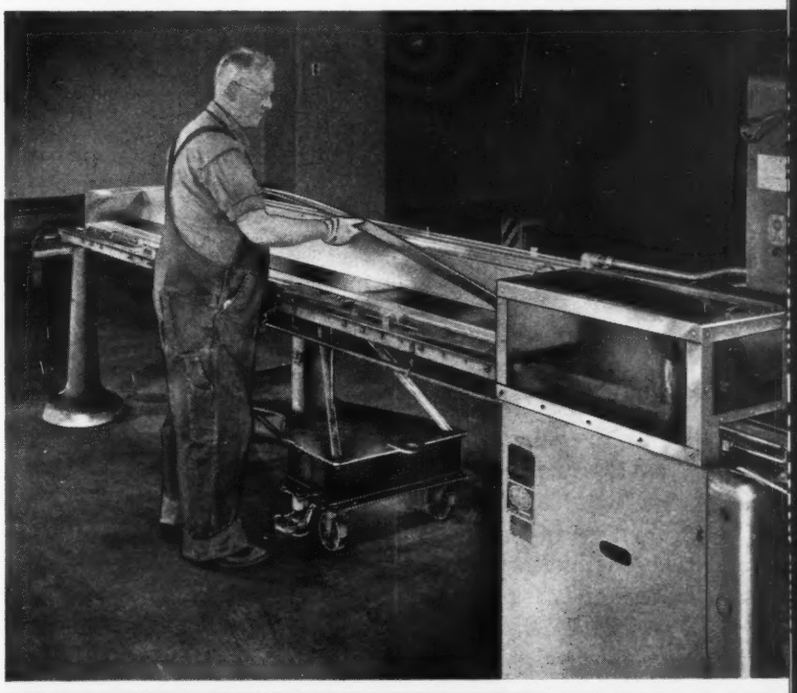


Fig. 2. (Top) Aluminum strip is fed between a set of forming rolls that produce a channel-shaped bead along each edge in a continuous operation

Fig. 3. (Center) Flying cut-off attachment at the end of the cold roll-forming machine and bench on which the cut lengths are stacked temporarily until used in the set-up seen in Fig. 4

Fig. 4. (Bottom) In this combined hydraulic press and tangent bending machine, aluminum strips are converted into half shells for a camera

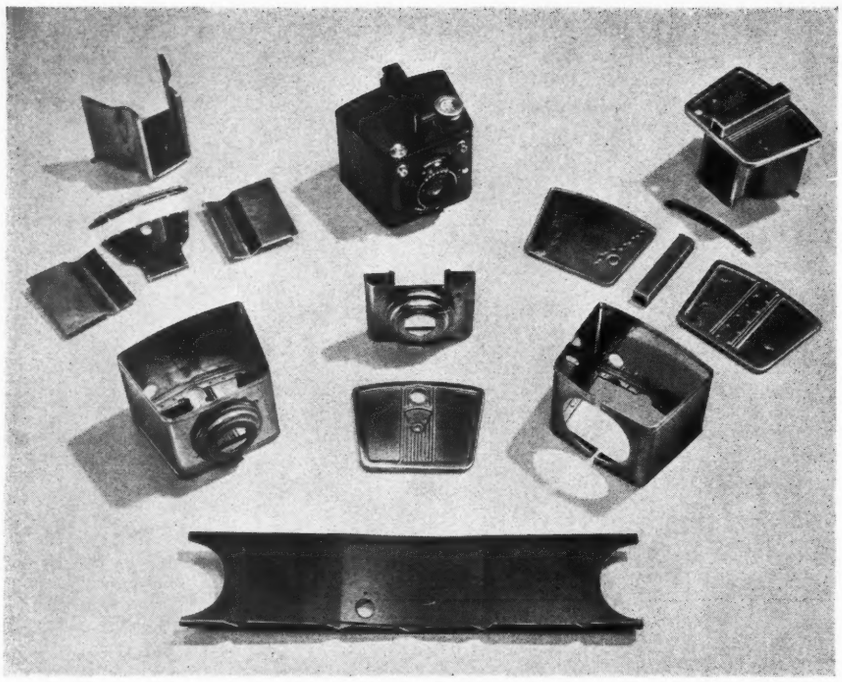


Fig. 5. Completed camera and the stampings from which the housing and several other components are assembled, chiefly by projection welding

welds fasten the sub-assembly, which includes the shutter cap, to the front portion of the wrap-around. Joints above and below the cap opening are barely seen. In the final assembly, all joints have to be light-tight, necessitating precise and close fitting stampings and well made welding fixtures. The fixture shown, as well as the others, effects clamping at or just before the instant that the welds are made.

Quite different from the stampings made from thin sheet are parts similar to the shutter case, Fig. 6, required for other model cameras. Such parts are produced from heavy-gage aluminum, and portions of the piece undergo marked changes in thickness in some areas. Because of these thickness changes, there is a considerable flow of metal within the work-piece. This requires the application of very heavy pressures in dies designed to produce a coining action. One such die, set up in a Bliss 1000-ton hydraulic press, is seen in Fig. 8. This die is employed for the final operation of coining the work-piece (shown at the left in Fig. 6), thereby converting it to the shape shown at the center and right.

For the initial operation of this shutter case, aluminum sheet 0.096 inch thick is first converted into circular blanks that are pierced with a centrally located hole. Next, the blank is drawn and the hole is extruded in an operation that makes the metal somewhat thinner in the collar around the hole than it was before extruding.

In the final coining operation, where very heavy pressure is applied, the metal is confined to make it conform to the die recess. The recess has a non-uniform section and differs considerably from the section of the work-piece as inserted. The hole in the work retains the same bore size as when extruded, but the collar, which

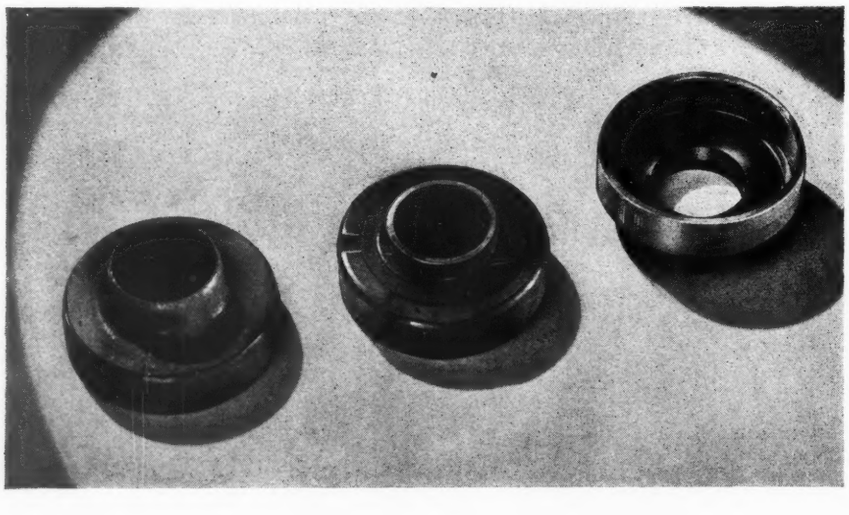


Fig. 6. Shutter case produced from a circular blank by drawing and extrusion (left), and then by coining in a hydraulic press (center and right)

was tapered, is made cylindrical and is much reduced in height. In other words, the metal is caused to move back, producing a shorter and much thicker collar than before. Also, bosses are formed on the flat horizontal surfaces.

The resulting shape is one that could be die-cast readily. However, the part would then have the characteristics and granular structure of a casting, whereas the stamping is of wrought metal, really constituting a cold forging.

The same press is also employed with another die to make an aluminum tripod head, Fig. 9, from a circular and slightly domed blank 2.200 inches in diameter by 1/2 inch thick. In this case, there is no collar to be extruded, but a short skirt is formed on the piece and three ball recesses to fit mating top ends for tripod leg extensions are produced by the coining action of the die. A central boss is also formed and serrations are produced on the top face to form a ring boss near the periphery.

Such coining, although it requires heavy pressure to make the metal flow, produces a strong and dense piece. Also, considerable machining is eliminated, since the milling of ball recesses and the knurling that would be needed if the part were to be cut from a blank or bar stock without coining are avoided.

Among the accessory parts produced at this plant is a magazine for 16-millimeter motion-picture film. Precise, as well as light-tight assemblies are required, as the film must be protected against fogging and the magazines fit into movie cameras which are, themselves, precision-built machines.

Fig. 10 shows a six-stage progressive die in a

Fig. 7. Final projection welding operation on the camera shell. The use of well made dies that fit the parts properly make the welds nearly invisible from the outside

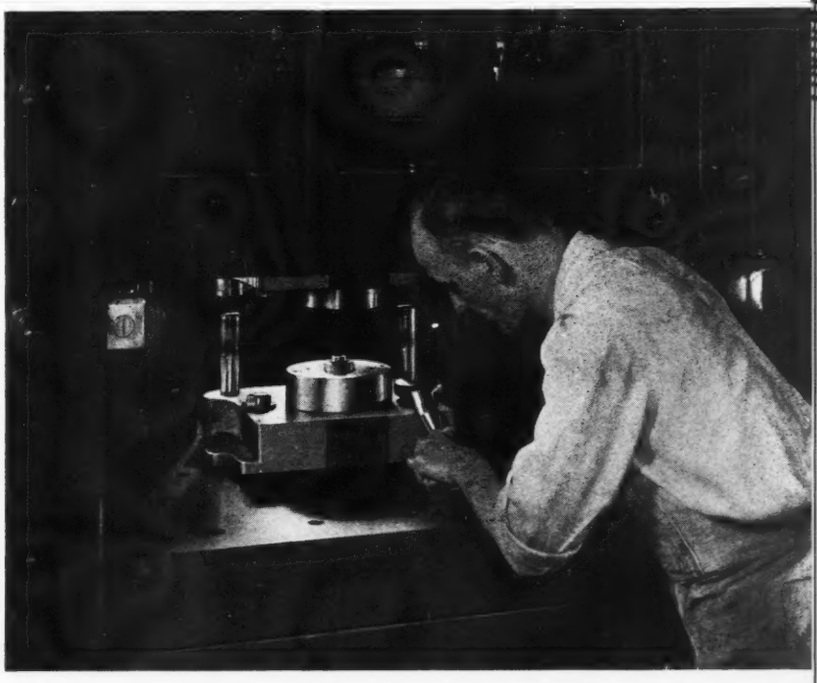


Fig. 8. Coining die mounted in a 1000-ton hydraulic press for performing the final press operation on the shutter case seen in Fig. 6

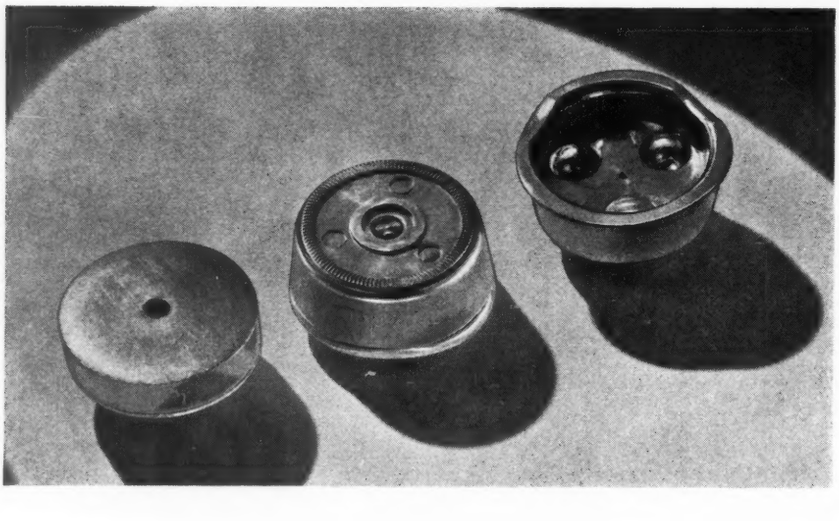


Fig. 9. Aluminum tripod head produced from a blank 1/2 inch thick and 2.200 inches in diameter by coining in a heavy press. The die forms ball sockets, a skirt, and serrations on the top face

Fig. 10. Progressive die set-up used in making covers for 16-millimeter movie-film magazines. The rate of production is forty a minute

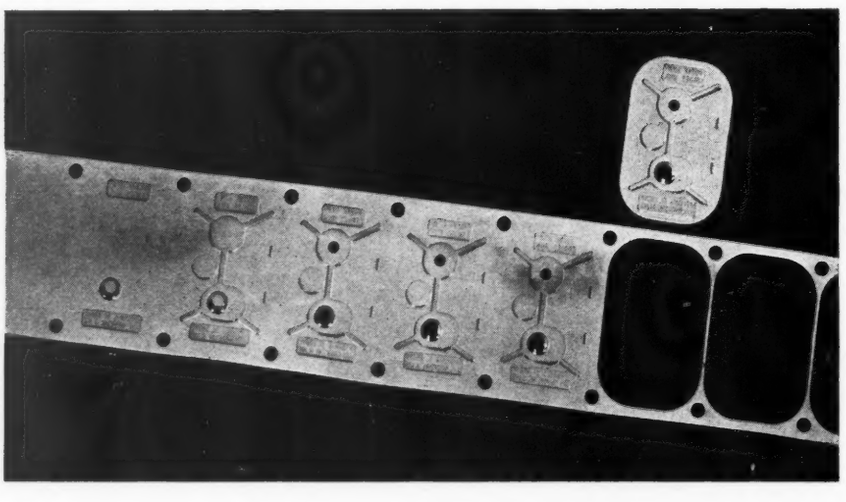


Fig. 11. Strip taken from die shown in Fig. 10. Piercing, embossing, and diamond indenting are done in first five stations. At the sixth station, the cover is blanked, after which the flange is drawn

Warco 100-ton press that makes 16-millimeter magazine covers, Fig. 11, at the rate of forty a minute from steel 0.020 inch thick. The coil stock is mounted on a Littell reel, and is fed automatically by Littell rolls, which straighten the stock as it is fed in. Other rolls feed the strip of scrap to a cutter, which makes recoiling unnecessary.

Successive operations, including the piercing of indexing holes, can be visualized by reference to the strip seen in Fig. 11. These operations involve chiefly piercing and embossing, the latter being performed partly to stiffen the piece. Some stiffening also results from the diamond indent pattern applied at Station 5.

At Station 6, the work-piece is blanked from the strip, and as the die is opened, a cross-slide transfers the work-piece to a separate drawing die near the front of the press. Here the part is dropped into position for drawing the flange all around the piece. This draw is made during the following stroke of the press, and the completed blank is ejected from the die into a chute leading to a tote box. Operation of this die is automatic, and when it is in use, the safety gate (shown elevated in Fig. 10) is kept lowered.

* * *

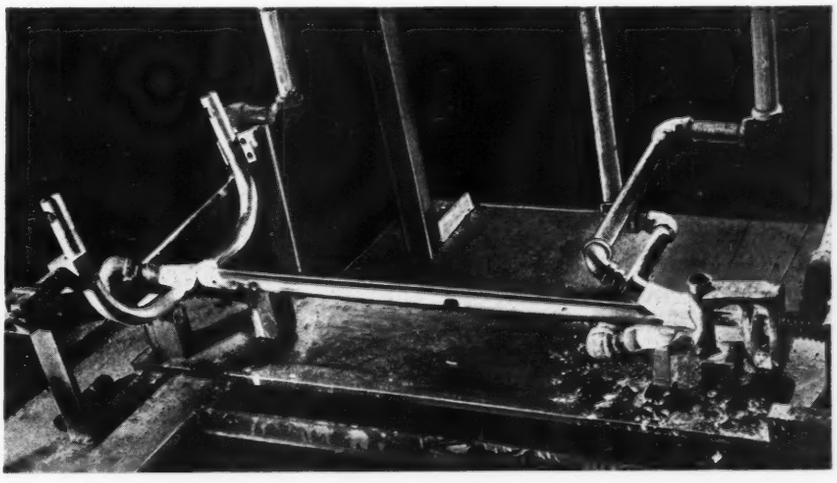
The National Production Authority has announced that a special three-man mission is being sent to Japan to appraise the machine tool industry of that country. Members of the mission will include Noble B. Clark, who is chief of foreign requirements in the Metal-Working Equipment Division of NPA—on leave from his position as export manager of the Warner & Swasey Co.; Charles DeVlieg, president of the DeVlieg Machine Co.; and Howard Kellogg, director of engineering purchases for the Ford Motor Co.

Centennial of Engineering

A Centennial of Engineering to observe the progress made in the engineering profession over the last one hundred years will be opened this year in Chicago at the Museum of Science and Industry, and will continue for five years. The celebration will comprise mainly an industrial exposition, and meetings of more than forty national and international engineering societies will be held during the period of September 3 to 13, 1952.

The specific aims of this project are to acquaint the public with the part played by the engineering profession and progressive management in the great industrial development of this country; to attract young men to study engineering, so as to meet the need for technically trained men in industry; and to bring together engineers from all over the world. Not only will technical advances be shown,. but also the social consequences of these developments. The exhibitions will focus attention on the basic principles behind our industrial development rather than on specific products. A dramatic stage production, motion pictures, and radio and television will be features of the program.

The men who are directing this great undertaking are Major Lenox R. Lohr, president of the Museum of Science and Industry, and state director of the Illinois Civil Defense; and Charles F. Kettering, director and research consultant of General Motors Corporation. It is stated that there will be a large representation of government officials and other dignitaries from all over the world. This is believed to be the first time in the history of engineering that the many widely varied branches of the profession have joined together as a unit to tell their story to the public.



Heavy-gage tubing and a bracket employed in tractor frames are brazed simultaneously in forty-five seconds by high-temperature radiant gas equipment manufactured by Selas Corporation of America. Every hour of the production day, 116 tractor frames are brazed in the plant of F. C. Castelli Co. of Philadelphia. Quality tests of the brazed frames have revealed that the brazed joints are at least as strong as any other part of the frame. Precision-controlled heating equipment burns an accurately proportioned mixture of gas and air within ceramic gas burners that deliver a uniformly high temperature, insuring smooth distribution of the brazing alloy

Materials OF INDUSTRY

The Properties and New Applications of Materials Used in the Mechanical Industries

General-Purpose Coiled Aluminum Tubing Now Available

A general-purpose aluminum tubing in coils, known as "Alcoa Utilitube," is now available from the Aluminum Co. of America, Pittsburgh 19, Pa. This tubing, made of Alcoa aluminum alloy B50S-O, costs less per foot than copper and other strong aluminum alloy tubing, and has good flaring and forming characteristics. It bends more easily than annealed copper, and work-hardens less under repeated bending. The new tubing exhibits high resistance to corrosion in many exposures, including seacoast atmospheres.

Uses include fuel-oil, gasoline, and lubricating oil lines for internal combustion engines; fuel gas lines for stoves and heaters; and air, vacuum, and hydraulic lines for brakes and instruments. Such fluids as kerosene, cutting compounds for screw machines and lathes, and refrigerants, with the exception of methyl chloride, can be handled. "Alcoa Utilitube" is available in lengths up to 1000 feet or more, depending on the diameter of the tube.

Metal Parts Cleaned and Conditioned by New Compound

"Klem-Kote," a cleaning agent that imparts an iridescent, crystalline, and adherent phosphate coating to the surface of metals is a new product of Klem Chemicals, Inc., 14401 Lanson Ave., Dearborn, Mich. A three-stage washer is used in the cleaning process. The first stage consists of immersing the metal parts in a solution of 1 ounce of the compound to 1 gallon of water for a minimum of one minute. This is followed by a hot-water rinse, and finally by a chromic-acid rinse. Light surface rust can be removed by keeping the metal parts in the first-stage solution for from four to five minutes.

When used in a spray type installation, all soil, including hydrocarbon oils and drawing compounds, can be removed. The phosphate coating produced retards rust and provides a good bond for industrial finishes. Successful applications of this cleaning compound have been made in the automobile, refrigerator, and other industries.

Non-Flammable, Non-Corrosive Hydraulic Fluid

The Monsanto Chemical Co., St. Louis 4, Mo., has announced a new type of non-flammable hydraulic fluid for pressure transfer application. "Pydraul F-9," as it is designated, is fire-resistant, non-corrosive, chemically stable, and easily pumped, in addition to having good lubricity.

It has a specific gravity of 1.266, a weight of 10.56 pounds per gallon, a pour point of plus 5 degrees F., a neutralization number of less than 0.1 before and after hydrolysis, a viscosity of 49.5 to 58.0 Centistokes or 229 to 268 S.S.U. at 100 degrees F. and 5.6 to 6.0 Centistokes or 44.5 to 45.8 S.S.U. at 210 degrees F., and an acidity of less than 0.1 mg. KOH per mg.

This fluid can be used in such equipment as die-casting machines, hydraulic presses, hydroelectric turbines, and glass drawing machines.

New Process for Coloring and Protecting Aluminum

Aluminum can be colored and given a protective coating in one operation by a new chemical process developed by Enthone, Inc., 442 Elm St., New Haven, Conn. Such colors as yellow, blue, green, gold, brass, etc., are imparted to the metal in this way. The salts used in this process are called "Alumox 44."

The coloring procedure consists of cleaning the aluminum part and then immersing it in a solution of these salts. Dyes are added to the processing solution, so that coating and dyeing occur simultaneously. It is stated that the process is equally effective on bulk work or large objects.

The salts are available as a powdered material, which is added to water in a concentration of one

pound per gallon. The bath operates in the temperature range of 190 to 210 degrees F., and coloring is accomplished in from fifteen seconds to two minutes.

The coatings produced are relatively non-conductive, and have a thickness of approximately 0.0001 inch. The process is not meant to be a substitute for electro-anodizing, being designed as a means of rapidly producing adherent colors on aluminum. In most cases, the finish is covered with clear lacquer. Almost all aluminum alloys can be treated successfully, including wrought and cast alloys. Objects that have been colored with success include aluminum hardware, jewelry, nameplates, automobile trim, bead chain, medallions, electrical fittings, and lamps.

Non-Drying Compound for Use in Fitting Mating Surfaces

"Bearing Blue" is a non-drying compound for use in spotting, scraping, and fitting of various machine component parts, which has been developed by the Dayton Rogers Mfg. Co., Minneapolis 7, Minn. It is obtainable in 4-ounce cans for average shop use.

Chemical Treatment Produces Rustproof Surface

Rubbing and sliding surfaces of iron or steel parts can be made rustproof by a chemical treatment announced by Octagon Process, Inc., 15 Bank St., Staten Island 1, N. Y. This phosphatizing compound, known as "Rustshield 2," produces a non-metallic coating, which, besides being rustproof, is absorbent, thus serving to retain lubricating oils. Parts are treated by hot immersion in the compound. It is applicable to such parts as thrust washers, pump pistons, gears, and valve roller pins, stems, and guides, as well as bearing surfaces of all types. Close tolerances are not affected by the treatment.

Resin-Impregnated Glass Fabric for Making Molds

A tacky, low-pressure laminating material composed of glass fabric impregnated with General Electric Permafil resin permits molding lay-ups to be made without the use of staples or other fastening devices. This impregnated glass cloth is being marketed as "Phenopreg LP-502" by Fabricon Products, Inc., River Rouge, Mich. Although tacky to the touch, it is easy to handle and does not deposit resin on the user's hands.

Molding is done at temperatures of about 300 degrees F., and at pressures ranging from 15 to 75 pounds per square inch. Lay-ups may be made of wood or plaster forms and molded by the vacuum bag method. Matched metal die molding may also be used. Parts molded have good moisture and chemical resistance and good electrical properties. The new material is being used at present for the low-pressure molding of aircraft tooling jigs and fixtures.

High-Pressure, Oil-Resistant Synthetic Rubber Molding Compound

The Parker Appliance Co., Cleveland, Ohio, announces a new rubber synthetic molding compound for O-ring seals used in tanks and other military vehicles. Parker Compound 90, as it is called, is said to have high heat resistance (up to 225 degrees F.), low compression set, and high hardness. It has a tensile strength of 1450 pounds per square inch, a percentage elongation of 210, with a value of 150 after aging, a hardness of 90 (Shore), and a volume swell in a seven-day hot oil test of 4.6 per cent.

Acid-Free Coolant and Lubricant for Machining Operations

A fire-resistant cooling and lubricating compound, free from abrasives and acids, has been developed by the Tap & Drill E-Z Corporation, Inglewood, Calif. The new product, known as "Lubri-Cut," clings to the tool, producing effective cooling and lubricating action in high-speed drilling, blind-hole tapping, countersinking, profile routing, swaging, etc. It is available in both paste and semi-paste form, and may be used on both hard and soft ferrous and non-ferrous metals and on plastics or glass.

Barrel Finishing Compound for Alloy-Steel Parts

The Blue Magic Chemical Specialties Co., Philadelphia, Pa., has brought out a chemical compound for barrel finishing alloy-steel parts. Blue Magic Compound No. C-5 can be used with any tumbling medium to obtain mirror finishes on steel parts in twenty to forty minutes.

The compound can be used in certain applications for both roughing and finishing to produce surfaces that are uniform in character. It is a non-dusting, non-irritating, soapy, concentrated powder. Owing to its detergency and rinsibility, parts leave the tumbling barrel free from any foreign matter that might impair subsequent plating, painting, or other operations.

Modified Machines Aid Production Change-Over

CHANGING from the production of engines to the manufacture of lawn mowers required modification of machines and other equipment at the Pioneer Gen-E-Motor Corporation, Chicago, Ill. One of the most interesting changes made in the equipment is illustrated in Fig. 2. As originally built by Richards, Badger-Packard Co., of Milwaukee, this machine was used for drilling and spot-facing seventeen holes in an engine assembly.

Now, with a different fixture and some changes in the drill-press head alignments, the machine is being used to drill and spot-face the lawn-mower end castings shown in Fig. 1 at the rate of 1200 pieces per day. The two vertical spindles are Delta 17-inch multiple drill heads having one high and two low speeds. In addition, five special Errington horizontal 14-inch multiple drill heads, a Bellows air feed, and a foot-operated clamping arrangement are provided.

The procedure in machining the work is as follows: After the operator places the parts in the fixture, as shown in Fig. 3, he steps on the foot-pedal to operate the air clamp. The air valve at the right starts the spindle feeds. The two Delta drill presses drive the vertical multiple heads for drilling two holes 0.323 inch in diameter and six holes 21/64 inch in diameter, as well as for producing eight spot-faces 1 inch in diameter. Special cutters permit drilling and spot-facing in one pass. Simultaneously with this operation, the horizontal heads drill four holes 0.228 inch in diameter and two holes 7/64 inch in diameter.

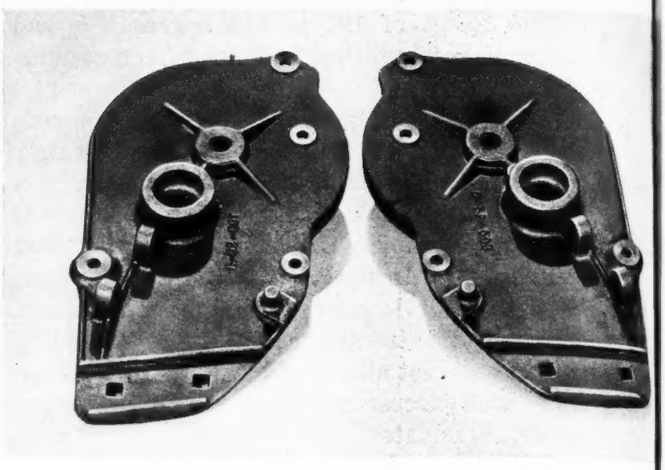


Fig. 1. Lawn-mower end castings in which eight holes are drilled and spot-faced by vertical multiple-spindle heads while six holes are drilled by horizontal heads

Fig. 2. Originally employed to drill and spot-face holes in an engine assembly, this machine was modified to produce holes in lawn-mower castings

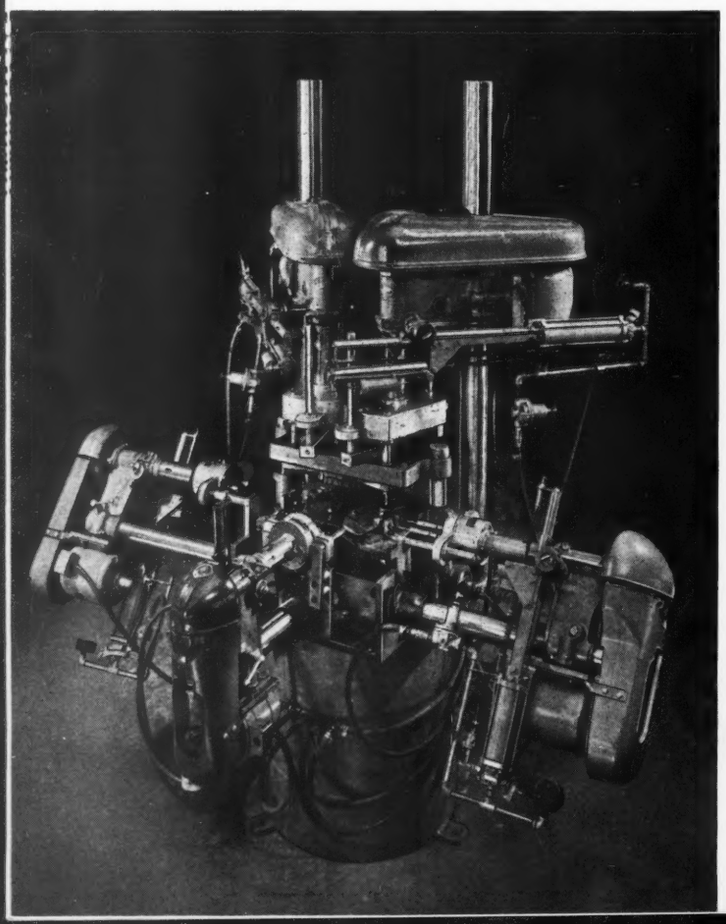
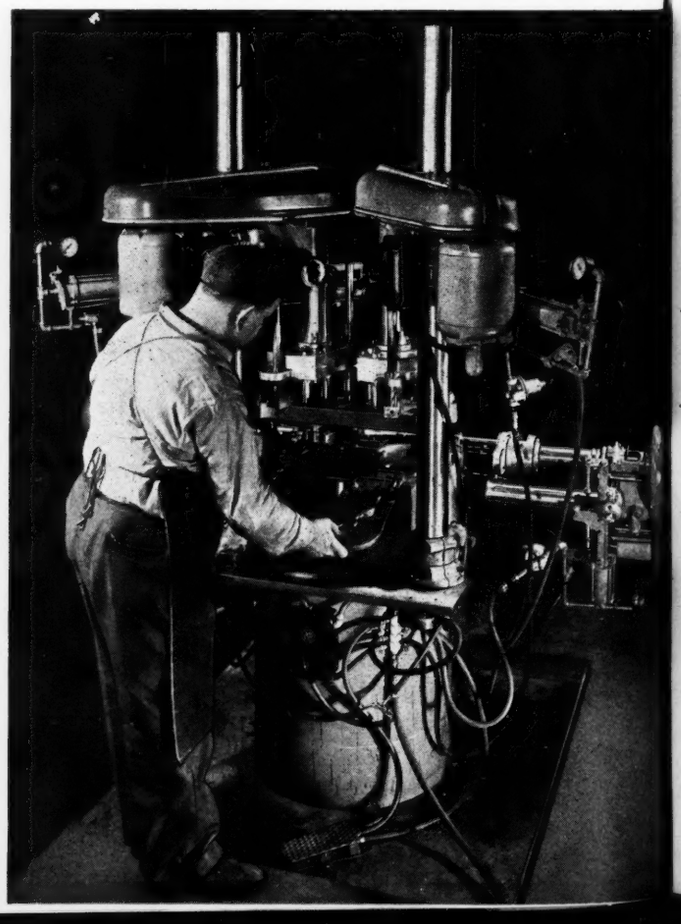


Fig. 3. In machining lawn-mower parts, the operator loads two castings into the machine and then operates a foot-pedal to actuate an air clamp



INGENIOUS *Mechanisms*

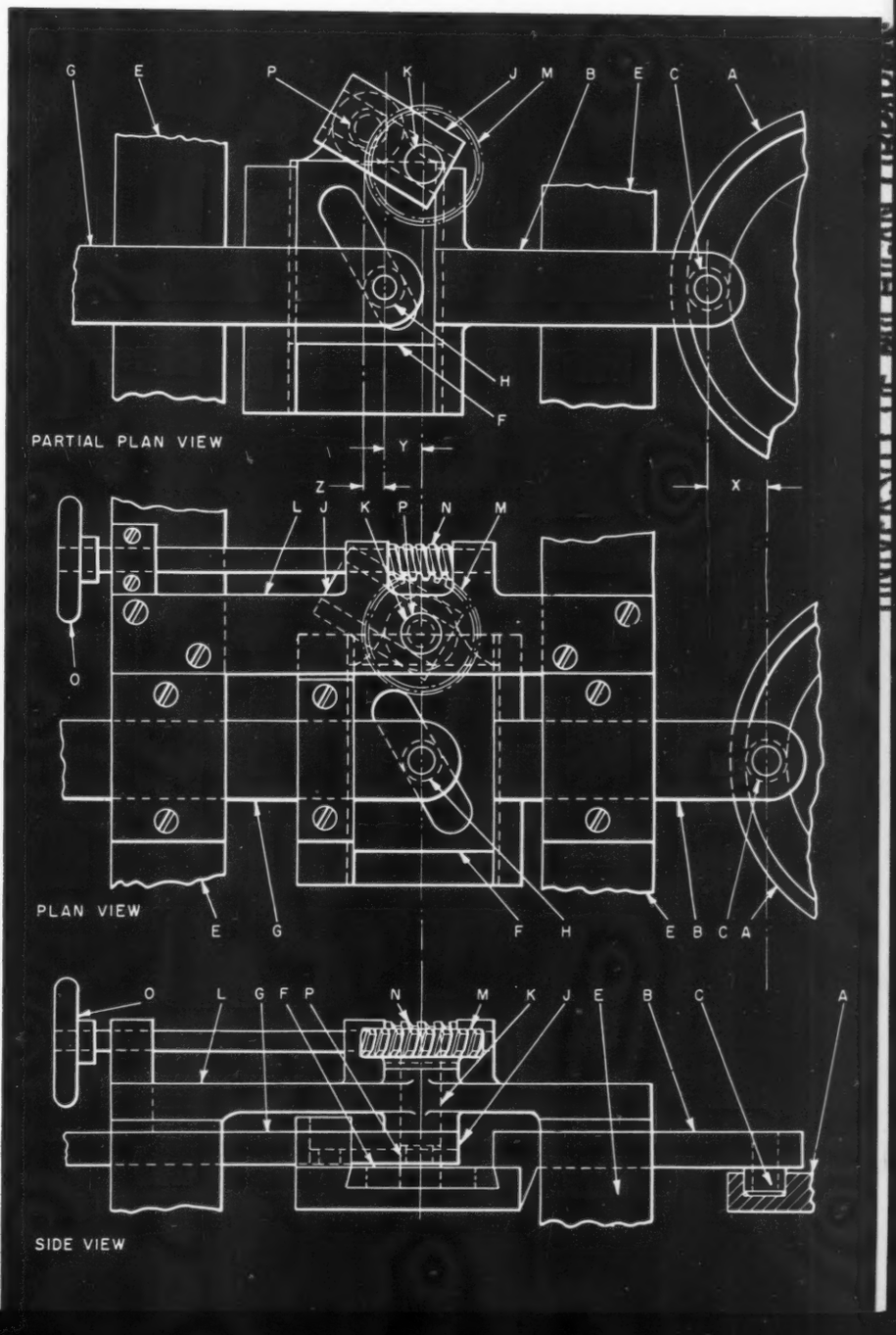
Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Variable Reciprocating Motion Derived from Uniform Rotation

By L. KASPER

On a machine used in making a formed wire product, the partly completed piece is transferred to various positions for the different operations. One of these transfer movements is accomplished by the use of an eccentric operating a reciprocating member. Owing to variations in the size of the work-pieces, it is necessary that the distance through which the part travels from the point of transfer be varied without stopping the machine. It is also necessary that the loading position, which is the location at which the cycle is started, remain unchanged, regardless of the adjustment in length of stroke.

The accompanying illustration shows a mechanism that was designed to obtain the desired variable reciprocating motion from uniform rotation of an eccentric. Eccentric *A*, which rotates at a uniform rate to operate the mechanism, transmits reciprocating motion to slide *B* through the follower *C*. This slide is supported in machine frame *E*, and carries another slide *F*, which is free to reciprocate in the dovetailed slot in slide *B*. Slide *G*, also supported in machine frame *E*, carries a roller *H* which engages an angular slot in slide *F*. At one end of slide *F* is mounted another roller *P*, which engages a groove in the adjustable block *J*. This block is keyed to the vertical shaft *K*, which is supported in bracket *L*. Shaft *K* also carries worm-gear *M* which meshes with worm *N*. The worm, mounted on bracket *L*, is rotated by handwheel *O* to adjust angle of block *J*.



Mechanism designed to obtain variable reciprocating motion of work-transfer slide (G) on a wire-forming machine from an eccentric (A) that is rotated at a uniform rate. The length of stroke of slide (G) is controlled by the angular setting of block (J), which can be varied by rotating handwheel (O)

In operation, the rotation of eccentric *A*, which is shown in the plan view (center sketch) with follower *C* in its extreme right-hand position, causes slide *B* to be moved to the left. As slide *G* is connected to slide *B* by roller *H* in slide *F*, slide *G* is likewise moved to the left. Also, since roller *P* operates in the groove in block *J* (which is shown set at an angle with relation to the line of motion of slide *B*), the movement of slide *B* causes slide *F* to be moved in a direction perpendicular to the movement of slide *B*.

This movement of slide *F*, caused by the action of roller *H* in the angular slot in slide *F*, results in motion being transmitted to slide *G*, in addition to the motion that is directly applied by the movement of slide *B*. However, because of the angularity of the slot in slide *F*, any movement of this slide in the direction shown produces motion of slide *G* in the reverse direction, or to the right. This reverse motion detracts from the movement transmitted to slide *G* by slide *B*, the movement of slide *G* being the resultant of the two motions.

In the partial plan view (top sketch), from which some of the parts have been omitted for clarity, slide *B* has completed its movement to the left, roller *C* having reached the high point on eccentric *A*. Also, slide *F* has been moved by the action of roller *P* in the groove in block *J*. Comparing the position of roller *H* in the plan view with its position in the partial plan view, it will be noted that its horizontal position relative to the center line of slide *F* has been moved to the right a distance *Z*, which represents the distance lost in the movement of slide *G* due to the upward movement of slide *F*. The actual movement of slide *G* is represented by distance *Y*, which is equal to the rise of the eccentric *A* (as indicated by distance *X*) minus the distance *Z* which is lost.

As previously mentioned, the angularity of block *J* can be adjusted by the handwheel *O* through worm *N* and worm-wheel *M*. If block *J* were set with its groove parallel with the line of motion of slide *B*, there would be no movement of slide *F* within slide *B*. As a result, there would then be no lost motion, and the movement of slide *G* would be equal to the movement of slide *B*. If block *J* were rotated counter-clockwise beyond this parallel setting, the resultant downward movement of slide *F* would cause an increase in the movement of slide *G* as compared with that of slide *B*. The setting of block *J* should not be perpendicular to the line of motion of slide *B*, or approach that position too closely, since this would cause binding.

It will be noted in the plan view (center sketch) that the axes of shaft *K* and roller *P* exactly coincide. This condition will exist at all times when roller *C* is at the low point on eccentric *A*, regardless of the angularity of block *J*. Therefore, the loading point of the transfer movement will remain unchanged, regardless of the stroke adjustment.

Disc-Stacking Device

By JOSEPH WAITKUS

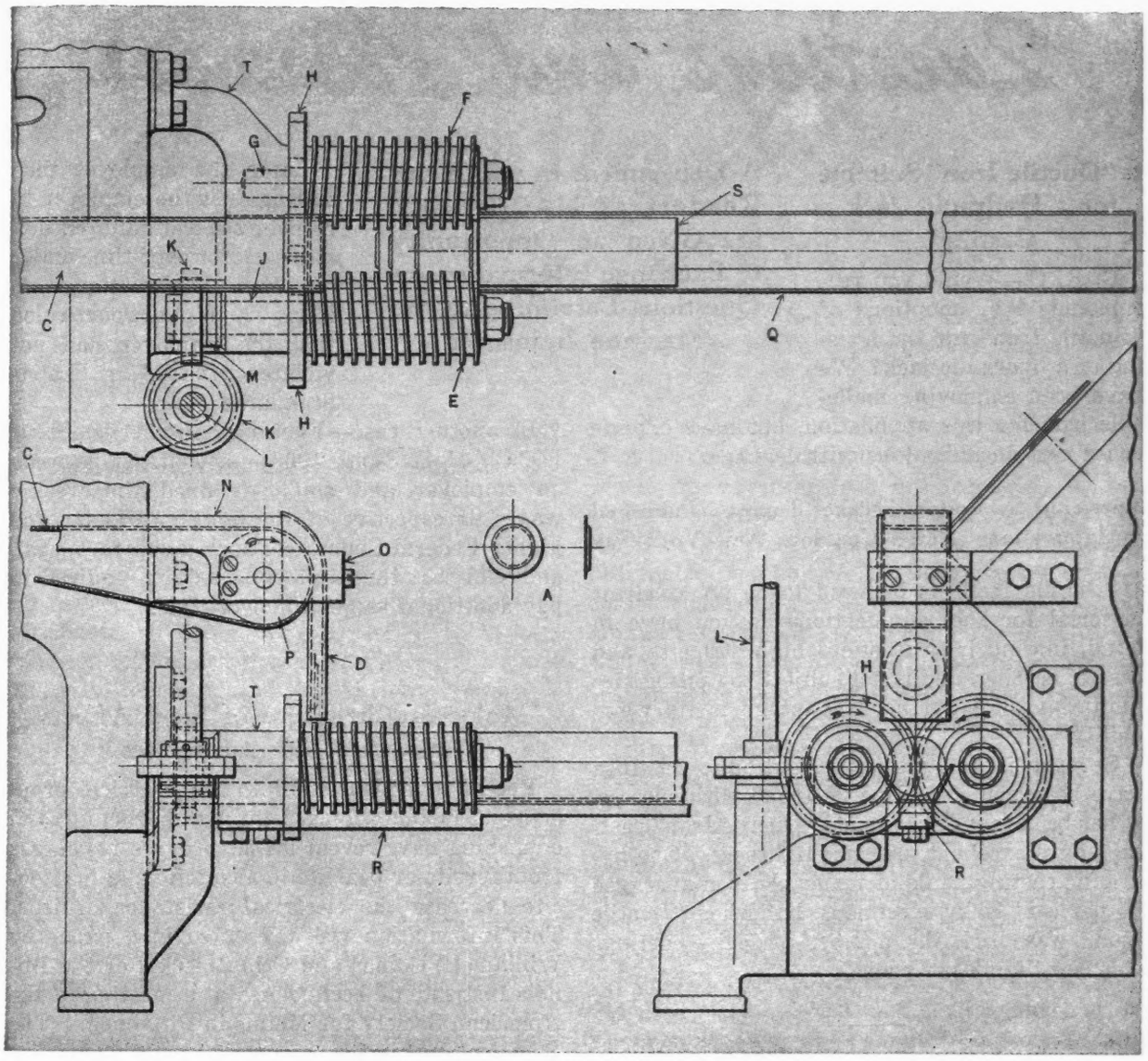
The power-operated device shown in the accompanying illustration is used for stacking discs like the one shown at *A*. The same arrangement can also be employed for other forms of discs or shallow shells. It is entirely automatic in operation, except that the attendant must remove the stack of discs when completed. The particular device shown has been in use for several years and has never given trouble or required repairs of any kind.

Discs *A* are stacked in piles of varying numbers after being punched out of sheet metal on an inclined press. The stacking device consists essentially of two feeding or work-traversing screws *E* and *F* with a special form of square thread. This thread is cut very thin to provide a large space between adjacent threads. The screws are identical in size and shape, with the exception that one has a left-hand thread and the other a right-hand thread.

The screw *E* fastened to the shaft *J* is driven from the main shaft *L* through a pair of spiral gears *K*. Two spur gears *H* transmit power to the screw *F*, which rotates on the shaft *G*. The entire mechanism is carried by a bracket *T* fastened to the press. Thrust bearings *M* are provided for the spiral gears.

A conveying arrangement consisting of a belt *C* and a pulley *P* delivers the disc to the chute *D*. The bracket *O* supports this conveying equipment. A guide strip *N* is provided at the side of the belt. The vertical chute *D*, which directs the discs from the belt to the screws *E* and *F*, is fastened to bracket *O*.

The operation of the device is very simple. The press, being inclined, discharges the discs on the conveyor belt *C*, which, in turn, carries them to the vertical chute *D*, through which they drop to a position between the threads of the revolving screws *E* and *F*. The screws advance the discs until they are discharged into the trough *Q*, which is supported by a bar *R* fastened to the bracket *T*. As the discs are deposited in the trough in an orderly fashion, the slug *S* is gradually pushed back. The trough is graduated so that the attendant can see when the desired num-



Device for stacking discs such as shown at (A)

ber of discs has accumulated. They can then be removed and the slug *S* pushed back to its original position.

As the stacking device receives its supply from a conveying belt, it can be located at any required point. The best results are obtained when the screws *E* and *F* revolve one revolution for each disc produced. At this rate, a smooth and orderly stack is obtained.

* * *

The world's largest vertical universal testing machine is to be installed in a new building on the campus of Lehigh University, according to a recent announcement. The hydraulic tension-compression testing machine will have a capacity of 5,000,000 pounds, and will cost approximately $400,000. A new building will be erected to house the equipment.

New Film on Corrosion

How corrosion causes an annual loss in industry and elsewhere, estimated at six billion dollars, is dramatized in a new sound-color film "Corrosion in Action," prepared by the International Nickel Co. In addition, the film shows some of the various means of avoiding corrosion, such as selection of corrosion-resistant materials; development of new alloys; and use of electric currents to provide cathodic protection.

The picture was made at testing stations, laboratories, and industrial plants in various parts of the country. It consists of three parts, each requiring twenty minutes of showing time. Any part or combination of parts can be shown independently of the others. Bookings can be made through the Corrosion Engineering Section of the International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.

Questions and Answers

A Department in which the Readers of MACHINERY are Given an Opportunity to Exchange Information on Questions Pertaining to the Machine Industries

Is "Ductile Iron" Suitable for a Hydraulic Jack Casting?

G. K. C.—Would you recommend the adoption of "Ductile Iron" for the housing of a hydraulic jack? We have been employing malleable iron for this application, but have experienced certain difficulties with leakage.

Answered by Editor, "Nickel Topics," Published by International Nickel Co., Inc., New York City

"Ductile Iron" is believed to be an excellent material for such applications as you have in mind, inasmuch as it offers high strength and ease of casting, and is not subject to casting size limitations. A further advantage is its weldability.

Several jacks and other hydraulic castings have been made of "Ductile Iron" with success. It has been found that sound "Ductile Iron" castings have excellent pressure-tightness. One hydraulic casting made of malleable iron averaged 15 per cent leaky specimens, but when "Ductile Iron" was used, the number of leaky castings was less than 3 per cent.

Liability under Fair Labor Standards Act

A. C. K.—Can a manufacturer of machinery pay straight daily or weekly wages to his employes without being liable under the provisions of the Fair Labor Standards Act?

Answered by Leo T. Parker, Attorney at Law
Cincinnati, Ohio

Yes, if the employer has written contracts with his employes stating that their daily or weekly wages include time and one-half for over-time beyond forty hours a week and double time for Sunday work. In the case of Watson vs. Hightower [176 Pac. (2d) 670] it was shown that certain employes were hired at an agreed wage per twelve-hour day. The employer and these employes signed contracts which stated that the wages per twelve-hour day included over-time for each hour that is worked in excess of forty hours per week, and double time for Sunday work.

Later the employes filed suit against the employer to recover several hundred dollars each for over-time under the Fair Labor Standards Act. The higher court ruled that the employer had not violated the Fair Labor Standards Act.

In another case—Fleming, Adm'r. vs. Stone [D. C., 41 F. Supp. 1000]—a contract between an employer and employes fixed the weekly wages, irrespective of the hours worked. The higher Federal Court held such a contract legal, and said that the employer was not required to pay additional wages for over-time.

* * *

Molecular Structure of Steel Affects Electrical Characteristics

Recent investigations into the electrical properties of metals achieved through hardening and quenching have revealed that progressive stages from ferrite or pearlite to austenite and martensite decrease the electrical resistance of iron. This information was presented in a paper by William H. Colner and Otto Zmeskal of the Illinois Institute of Technology, at a meeting of the American Society for Metals in Pittsburgh. The electrical properties of steels, especially when applied in aircraft production and industry, are highly important. The successive stages in the heat-treatment of a metal, which result in different molecular arrangements, have been found to impart variables in the electrical properties of the metal.

The investigations showed that on being returned to the ferrite stage, iron recovered—at least to a noticeable extent—its original electrical property. With stainless steel, some different reactions were noted. The direction of resistance changes in martensite and pearlite reactions was just the opposite to that occurring in iron. That is, the resistance decreased when the austenite transformed to martensite or pearlite. The greater change in resistance due to the transformation from austenite to ferrite compared with the transformation from ferrite to austenite probably is caused by the considerable difference in temperature of these two reactions. This effect has been noted in iron-chromium-carbon alloys.

TOOL ENGINEERING *Ideas*

Tools and Fixtures of Unusual Design and Time- and Labor-Saving Methods that Have been Found Useful by Men Engaged in Tool Design and Shop Work

Specially Designed Tools for Rough- and Finish-Boring Steel Car Wheels

By MICHAEL AXLER, Los Angeles, Calif.

The rough- and finish-boring of steel subway car wheels to meet axle dismounting pressure specifications within the range of 65 to 75 tons has been accomplished successfully and at a great saving in tool costs and time through the use of Kennametal tools and special holders designed as shown in Figs. 1 and 2.

The Kennametal rough- and finish-boring tools and their holders are made to fit a four-tool (two roughing and two finishing tools) Type L-David boring-bar in a Niles wheel boring machine, as shown in Fig. 4.

Grade K3H Kennametal is used for the roughing operation, and K8 for finishing. A primary cutting clearance of 5 degrees is employed on the roughing inserts, while 13 degrees has been found more desirable on the finishing inserts. A parallel chip-breaker, 1/8 inch wide by 0.020 inch deep, is provided on the roughing inserts only.

The two roughing tools are accurately set for over-all length in a set-up fixture, Fig. 3, having a dial micrometer; a set-screw is used for longitudinal adjustment of the insert to obtain the correct dial reading. The same procedure is followed in setting the two finishing tools. The setting fixture is so designed that an Allen wrench can be used to advance the set-screw while the holder is in position, thus giving a direct length reading on the dial micrometer.

A maximum of 0.016 inch of stock (0.008 inch per tool) is left on the diameter by the roughing operation for removal by the finishing tools. Roughing inserts are reground to a template free-hand, so that the diametrically opposed tools will operate at the same depth when set up in their holders as described.

Finishing inserts are reground free-hand on a diamond wheel. Since the finishing tools cut on the end only, they are checked to make sure that

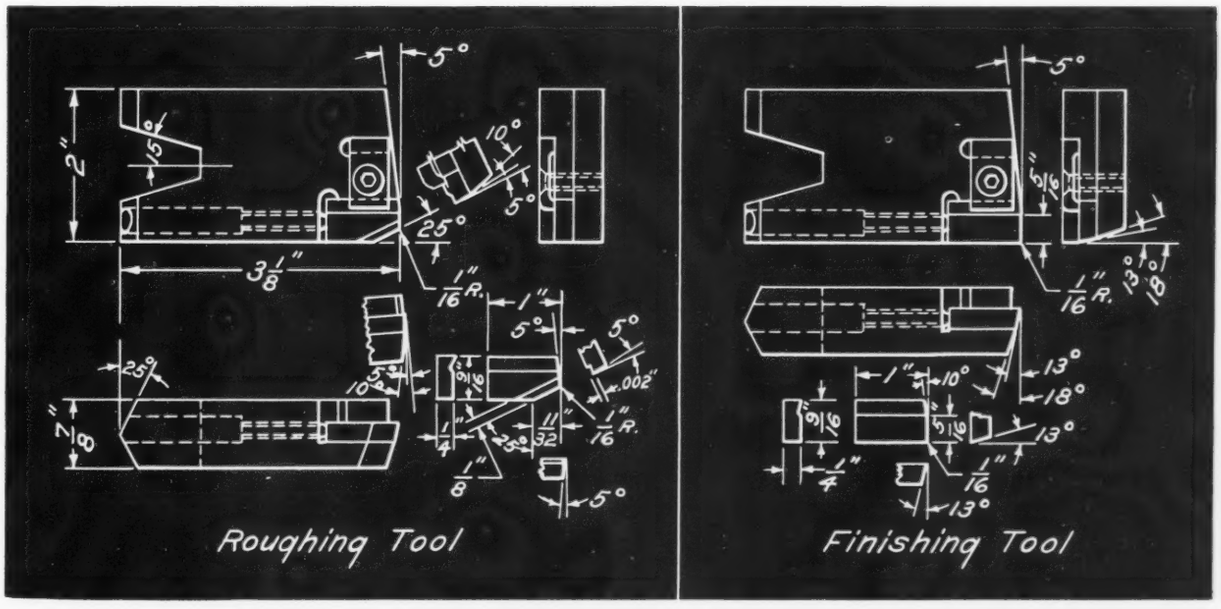


Fig. 1. Details of Kennametal roughing and finishing tools and holders used in machining the bores of steel car wheels

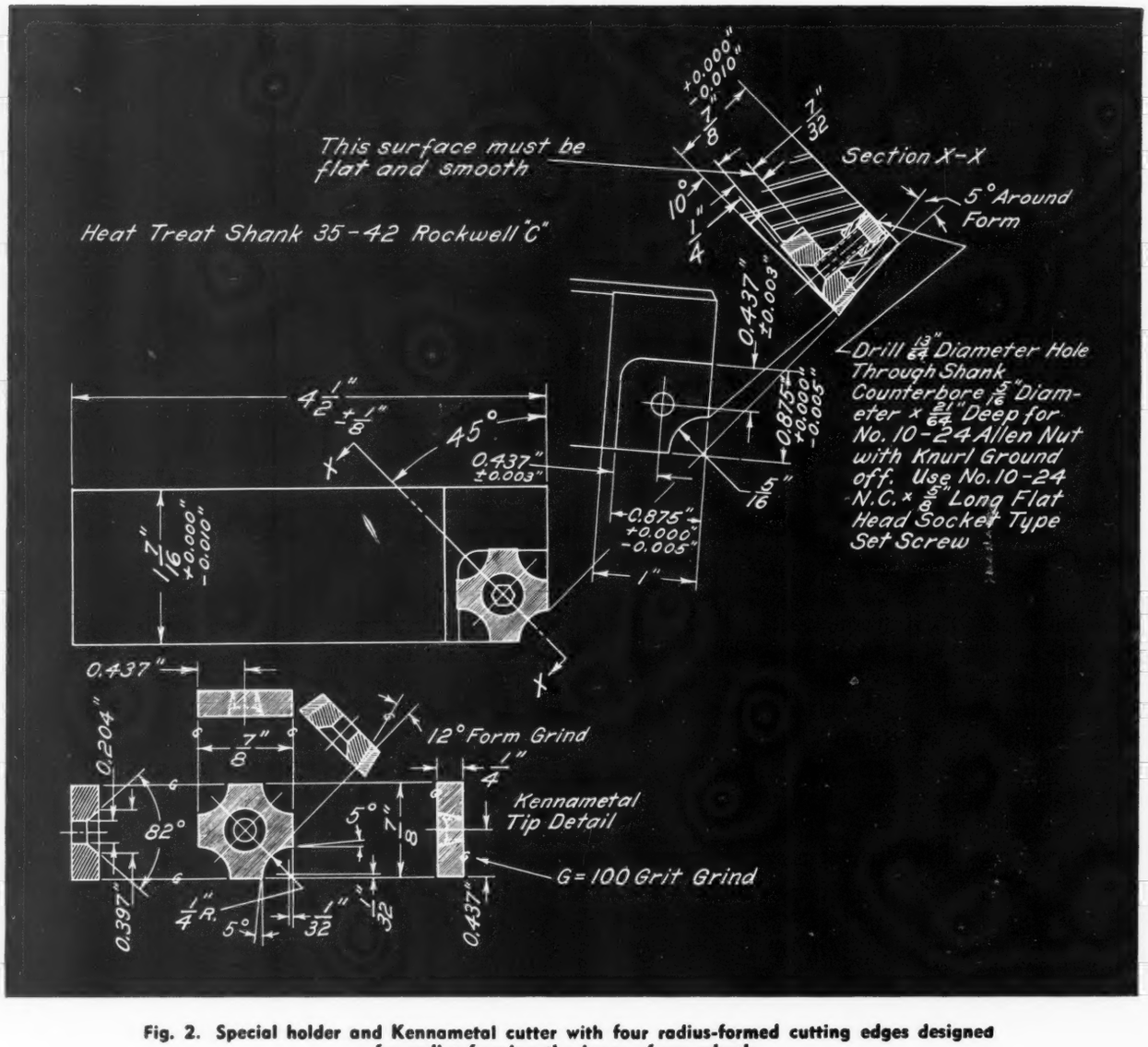
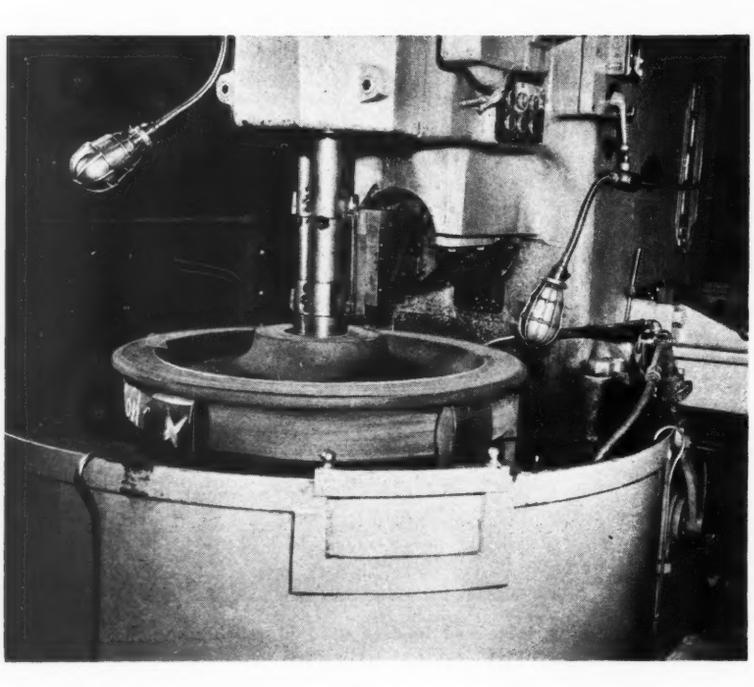

This surface must be flat and smooth
Heat Treat Shank 35-42 Rockwell "C"
Section X-X
5° Around Form
Drill 13/64" Diameter Hole Through Shank Counterbore 5/16" Diameter x 21/64" Deep for No. 10-24 Allen Nut with Knurl Ground off. Use No. 10-24 N.C. x 5/8" Long Flat Head Socket Type Set Screw
12° Form Grind
Kennametal Tip Detail
G=100 Grit Grind
45°
82°

Fig. 2. Special holder and Kennametal cutter with four radius-formed cutting edges designed for radius-forming the bores of car wheels



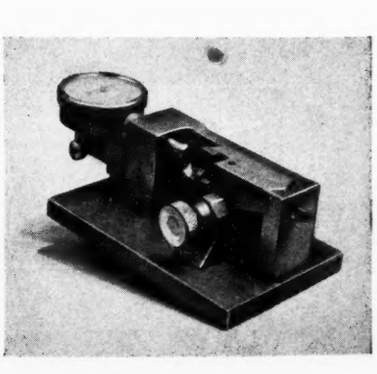


Fig. 3. (Above) Set-up fixture used in setting Kennametal inserts in holders of both rough- and finish-boring tools

Fig. 4. (Left) Niles wheel boring machine with Kennametal rough- and finish-boring tools set in four-tool boring-bar for machining car wheel bores

the leading cutting edge is square with the end. It was found that finish-grinding the inserts with a diamond wheel of 220 grit and then lapping with a diamond lap of 400 grit made it possible to finish-bore more wheels between the tool sharpening operations.

The roughing tips permit boring an average of seventy-five wheels per grind, while the finishing inserts permit an average of sixteen wheels to be bored per grind. When wear between grinds of the finishing inserts was allowed to reach a maximum of 0.0003 inch, it was found to induce chatter, which was reflected in the quality of the finish.

For machining the radius in the bore, a special Kennametal tool designed as shown in Fig. 2 was employed. The tip of this tool has four radius-formed cutting edges instead of one as in the original tool. More than 500 wheels have been machined by this tool without impairing its cutting efficiency. For finishing the hub, a Kennametal standard clamp type tool and tip is used.

The rough- and finish-boring operations on the 36-inch wheels were performed on a Niles wheel borer with the tools illustrated. A spindle speed of 95.2 R.P.M. was used, compared with a speed of 39 R.P.M., which was employed with high-speed steel tools. The surface speed for the Kennametal tools was 182.2 feet per minute, as against 71.4 feet per minute for the tools previously used. A feed of 4.5 inches per minute was used for the new tools, as against a feed of 4 inches per minute. The depth of cut was only 0.008 inch for the Kennametal finishing tool, compared with 0.040 to 0.060 inch for the high-speed steel tools. The cost of the tools formerly used, compared with that of Kennametal tools, was in the ratio of 26 to 2.88.

Jig with Adjustable Bushing Plate

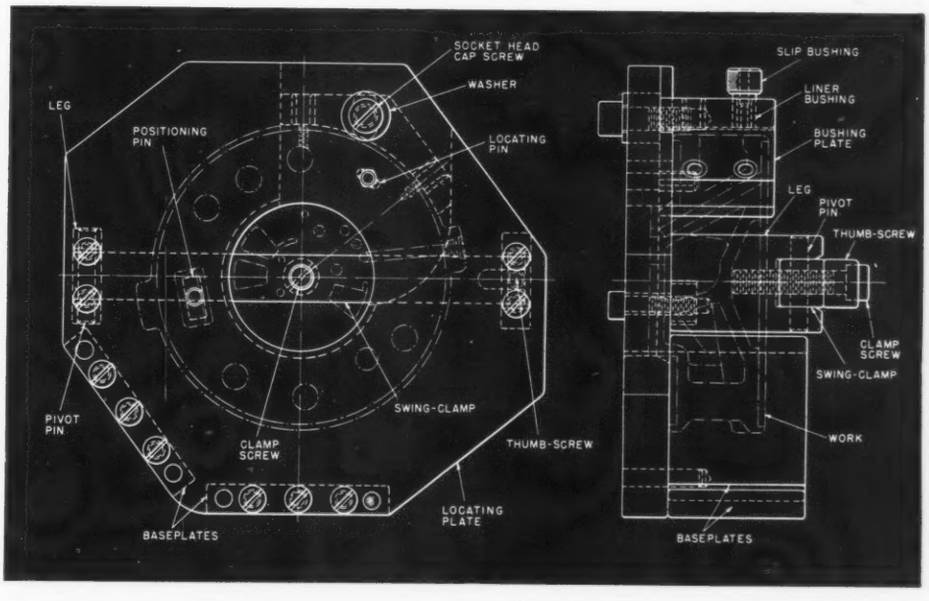
By ROBERT W. NEWTON, Poughkeepsie, N. Y.

The jig here illustrated is employed for drilling and tapping four radial holes in the periphery of rotary valve-seats for air-brakes. To compensate for variations in the diameter of the castings to be machined, it is provided with an adjustable bushing plate. The inner radius of the plate is the same as that specified for the periphery of the rough-cast valve-seat. Since the plate can be adjusted radially, over-size as well as under-size castings can be correctly positioned to maintain the required spacing between the holes to be drilled.

The jig contains a vertical locating plate, in the bore of which the centrally cast hub on the work-piece is a sliding fit. A pin driven into this plate enters a hole in the casting to locate the work radially. Another positioning pin in the locating plate enters a cored hole in the casting, thus preventing the work from being placed on the jig in the wrong position.

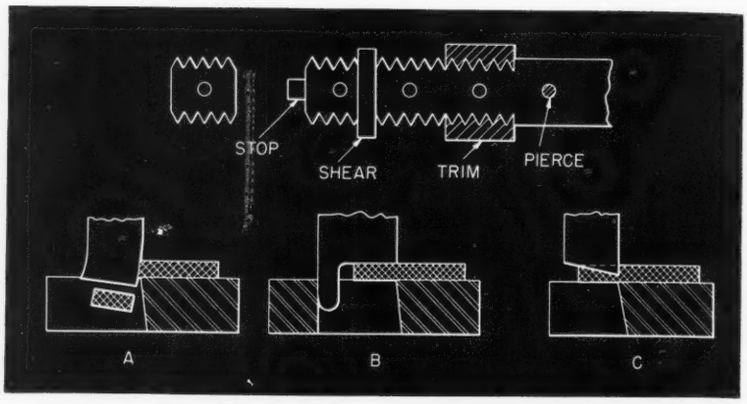
The adjustable bushing plate slides in a groove in the locating plate. It is held to the locating plate by means of a socket-head cap-screw and washer. A slot in the bushing plate allows it to be moved into contact with the periphery of the casting, in which position it is locked by tightening the screw. Liner bushings are pressed into holes in the bushing plate, and slip bushings of the correct sizes are provided for guiding the drills.

Two diametrically opposed legs are secured near the edges of the locating plate. A pivot-pin, driven through one of the legs, serves as the fulcrum for a hinged swing-clamp. When the cast-



Jig used for drilling and tapping four radial holes in the periphery of rotary valve-seats. An adjustable bushing plate compensates for variations in the diameter of the cast work-piece

ing has been located in the jig, the swing-clamp is fastened in place by means of a thumb-screw that is provided in the end of the other leg. A screw in the center of the swing-clamp is then turned until the work is secured tightly against the locating plate. Two baseplates, on each of which the jig rests while two of the four holes are being drilled and tapped, are screwed and doweled to the locating plate, diametrically opposite the bushings.



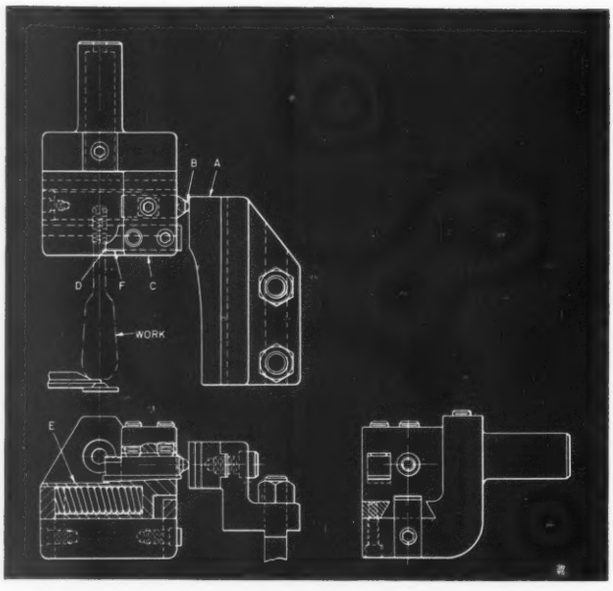
In operation, trimming punches have a tendency to bend as seen at (A). This can be overcome as indicated by views (B) and (C)

Profiling Tool for Automatic or Hand Screw Machines

By JOHN J. McNEFF, Irving, Tex.

The profiling tool illustrated was designed to produce a "clevis terminal," shown by dot-and-dash lines, on a No. 2 Brown & Sharpe automatic screw machine. When the tool has been indexed into position, the front-slide cam of the machine advances the guide piece *A* into contact with the frictionless roll *B*, which operates the tool-carrier slide *C*. The carrier-slide is advanced to a predetermined depth, indicated at *D*, and the tool is fed forward by the lead cam. The pressure of spring *E* causes roll *B*, slide *C*, and the cutting blade *F* to follow the required contour.

In this particular case, the lead cam dwells, so that the head of the part is formed by advancing the tool with the front cross-slide. A telescopic support bushing may be used in the tool shank.



Profiling tool for producing formed parts in hand or automatic screw machines

Design of Trimming Punches to Eliminate Bending

By FEDERICO STRASSER, Santiago, Chile

The work-piece shown in the upper view of the accompanying illustration originally was blanked with a rather complicated punch, but is now made much more easily and cheaply with a trimming and shearing die, as indicated diagrammatically.

Trimming punches, however, have a drawback in that the entire outside contour is not used in cutting, and there is, therefore, a tendency for the punch to bend away from the cutting force, as shown at *A*. This produces stresses in the punch, and also affects the quality of the work. To avoid this trouble, trimming punches and dies are often made wider than is strictly necessary to provide the punch with a heel, as seen at *B*, that enters the die before the punch touches the stock. In this way, the die supports the punch, so that it will not bend during the trimming operation.

Another way to solve this problem is to bevel the face of the punch, as shown at *C*. The wedging action of the bevel forces the punch toward the stock, thus counteracting its tendency to bend away from the stock.

The exact amount of the bevel angle is important, but can be determined only by practical trials. It depends upon such factors as thickness and hardness of the stock and die clearance. The best method is to begin with 5 or 6 degrees and increase or decrease the angle according to the results obtained.

* * *

For every ton of scrap used, this country conserves approximately two tons of iron ore, one ton of coal, and nearly two tons of limestone, as well as other materials.

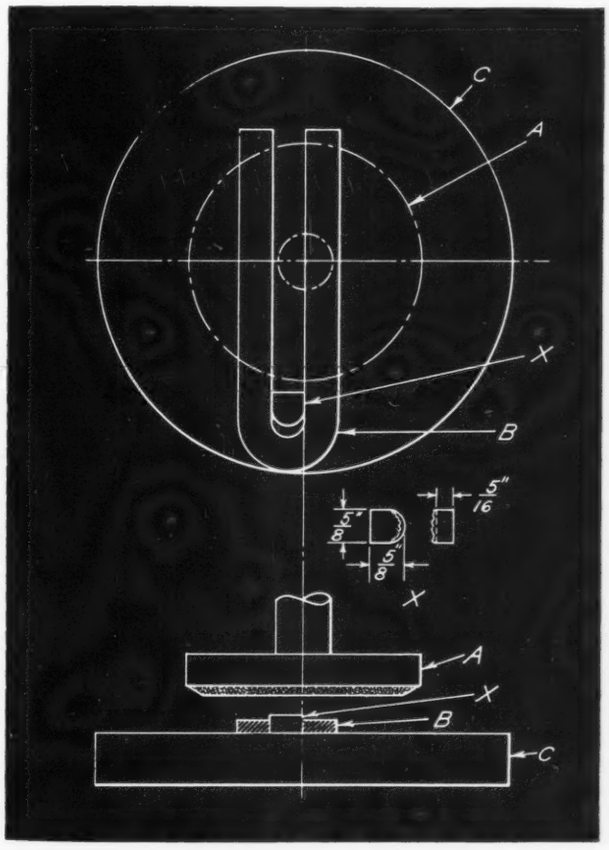
Ideas for Shop and Drafting-Room

Deburring Flat Surfaces on a Drill Press

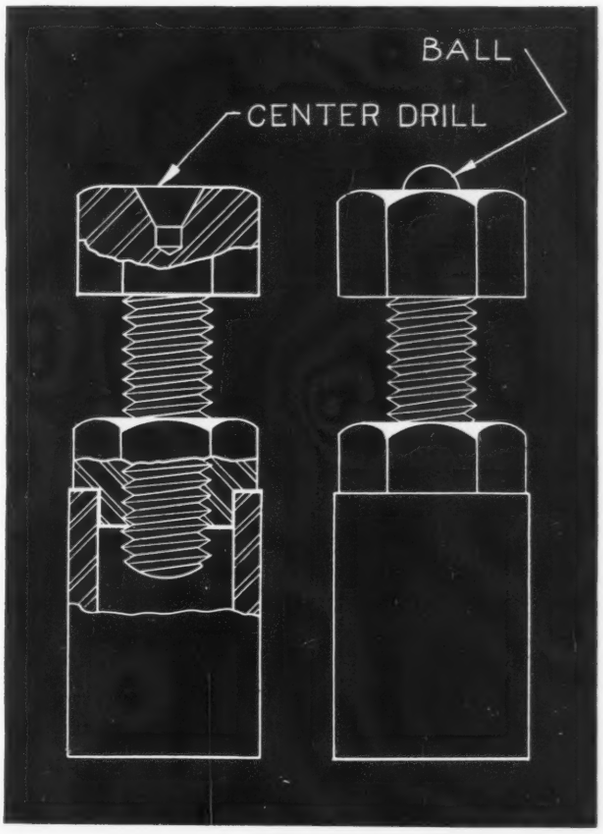
By DONALD BAKER, Boonton, N. J.

Heavy burrs produced on flat brass parts such as illustrated at *X* during a contour milling operation required considerable time to be removed by filing. Also, it was difficult to maintain the desired flatness of the surfaces if the parts were deburred on a sanding machine. To overcome these difficulties, the simple set-up shown in the illustration was devised for use on a drill press.

The shank of a sanding disc *A*, 4 inches in diameter and having a beveled edge, is held in the chuck of the drill press. A U-shaped steel guide *B* is clamped to the table *C* of the machine. With a deburred work-piece mounted in the guide, the spindle is lowered until the sanding disc contacts the completed part, and is then clamped in this position. Parts to be deburred can now be placed in the guide and fed beneath the disc. By setting the guide off center as shown, the disc will automatically feed the parts through the guide.



Simple set-up employed on a drill press for deburring part (X) with a sanding disc (A)



Jack made from a cap-screw, a nut, a steel ball, and a length of pipe

Jacks Made from Pipe Simplify Shop Set-Ups

By JOSÉ SOBKOWIAK, Jackson, Mich.

The machine jack here illustrated can be used in various shop set-ups. It can easily be constructed from a cap-screw, a nut, a steel ball, and a suitable length of ordinary pipe. As shown, a shoulder is turned on the nut to permit it to enter the pipe bore freely.

The head of the cap-screw is center-drilled to receive a bearing ball. The ball prevents the jack from moving under load, since it will make a small indentation in the work that the jack is to support. Of course, several lengths of pipe can be cut for use where more or less height is required.

* * *

In the United States, it takes the income of two average persons for an entire year to meet government costs for a single second.

THE SALES ENGINEER AND HIS PROBLEMS

By BERNARD LESTER
Lester and Silver
Sales Management Engineers
New York and Philadelphia

How Can We Develop Peace of Mind?

AN experienced sales engineer in the Middle West writes: "How can a salesman keep his peace of mind on an hour-to-hour basis? He misses contacting an important prospect; fails to get vital information; has three urgent places to go; has just lost an order. Constantly faced by obstacles of this kind, it is hard not to become upset."

Most sales engineers have had the same experience as our correspondent. In a single day, we may wrestle with a host of problems and conflicts. One vexing obstruction follows another. In our discouragement, each seems insurmountable. But if we can find a technique for developing peace of mind, we can take these troubles in our stride.

Peace of mind is one of the chief ingredients of happiness. Without it, we can't consistently succeed; we can't keep healthy; we won't be fit to live with over the twenty-four hour day. Peace of mind is contentment. It comes from accomplishment, even though our every wish is not gratified. Unlike satisfaction, which may follow a certain act, contentment can become a broad principle or characteristic of our philosophy of life. Here are some suggestions for developing permanent peace of mind.

1. Get our motives right. There is a growing realization that in business, politics, sports, and pleasure compromises are too often made with unethical principles. The young president of a thriving corporation recently said:

"There is too much wealth in this country without anybody working for it. There is too much politics without any principle behind it. There is too much pleasure without any conscience on the part of the pleasure-seekers. There is too much worship in churches without any sacrifice on anybody's part."

2. Take a look at ourselves now and then. Just sit in the audience and watch ourselves act on the "selling stage." See the play as a whole and how misunderstandings, petty gripes, suppressed desires, or outbursts of emotion usually shape the plot and weave cobwebs of frustration. By doing this, we develop a perspective, more charity, and better perception. Pride will tend to replace conceit. We can see the numberless unfounded worries that destroy peace of mind. One salesman asked "Ever go to a planetarium?" Then said, "It's a grand place to learn how insignificant we are."

3. Learn to make decisions—not only carefully but quickly. Then stick by them until proved wrong. We must cultivate sizing up the "Do's" and the "Don'ts." "How do you make an important decision?" I asked a supervisor. "Take a blank sheet of paper," he said. "Draw a line down the middle, and jot down on each side all the pro's and con's. Most always, with the facts, the decision is evident. I don't worry as long as my batting average is good."

4. Learn to forget. Packaged memory training courses are available to all of us, but how about courses on the art of forgetting? What to remember is exceedingly important, but what to forget is equally so. Recalling this or that rebuff or failure disturbs our peace of mind. Replace such recollections by those marked with success.

5. Detect humor wherever possible. Few events occur that don't have humor, as well as interest. One salesman I know, after a hot fight for an order he has lost, always has a smile on his face and some cryptic remark related to the incident. Once as we jumped into his car after he had lost an order, he remarked: "Ever go to a zoo, look at a monkey, and wonder which one of us has the most sense?"

6. Go more than half way in cooperating with

people. The long record of human reactions has repeatedly proved that in our contacts with the other fellow, sooner or later an icy relationship will melt if we only persist in the warmth of friendship.

7. Cultivate an even pace, just as the tortoise did in winning the race with the hare. So many of us anxiously rush in to clean up some situation quickly. We may be badgered by a prospect. All this produces worry and strain, which ultimately work against us and cause waste. Success follows doing one thing at a time, and doing it deliberately. Composure brings peace of mind. It can help us to be master of our job, rather than letting our job be master of us.

* * *

Special Technique Required in Soldering Aluminum

Because of its relatively high thermal conductivity and great affinity for oxygen, aluminum is not as easily soldered as steel, brass, copper, or tin. Distortion also enters the picture because of the high coefficient of expansion of aluminum, which is double that of most other metals. Added to these difficulties is the fact that while most soldering is done at 375 to 400 degrees F., the range for soldering aluminum is from 550 to 700 degrees F.

Some information on the procedure required for successful soldering of aluminum is given in a recent issue of the *Technical Advisor*, published by the Reynolds Metals Co., Louisville, Ky. The soldering of aluminum, it is stated, is generally confined to small parts. With present procedures, the practical limit for aluminum sheets is 20 square inches of soldering area.

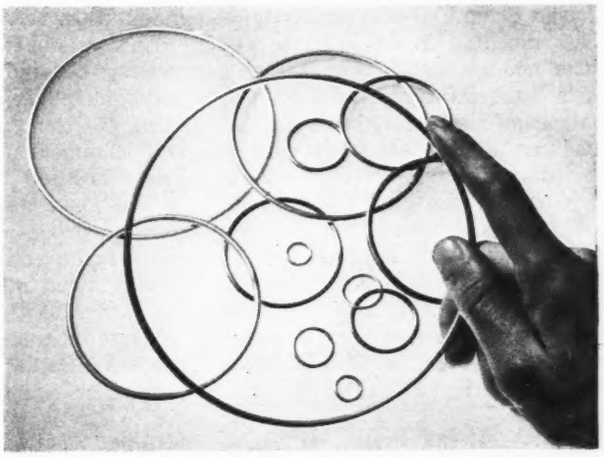
One of the difficulties encountered in soldering aluminum is that when this metal is exposed to the atmosphere, an oxide coating immediately forms on the surface. As the tinning solder cannot be bonded to this oxide, the coating must be removed before soldering. There are several methods of removing this coating. In one—the most widely used—the aluminum oxide coating is dissolved and kept from reforming by the use of a suitable flux. In another method, no flux is used. Instead the oxide coating is broken up by mechanically abrading the surface through the upper layer of molten solder.

A third method, which appears to offer the most interesting possibilities, is the vibrating of the work at supersonic frequencies. This breaks up and helps remove the oxide film. However, the power output of present equipment appears to be sufficient for small parts only.

Pressure-Filled Metallic "O-Rings" for Static Seals

Hollow metal tubing rings filled with inert gas at a pressure of 600 pounds per square inch are providing a new answer to static sealing requirements in a wide range of applications, according to United Aircraft Products, Inc., Dayton, Ohio. This corporation has recently been licensed by the Wills Ring Co., Bridge Water, England, to produce the new metallic "O-Rings," as they are called, for distribution in this country.

These rings are said to offer positive metal-to-metal static seals wherever problems of heat, pressure, corrosive liquids, or gases are involved. It is claimed that they are dimensionally stable under heat or cold, are not affected by age, and are impervious to oils, gases, or aromatic mixtures. Installations can be made in existing ring grooves and in free machined recesses. By the use of a special compression limiting device, which can be incorporated in the rings, they can be installed without grooves or recesses.



Ring seals of hollow tubing filled with inert gas, which are designed to maintain a positive metal-to-metal static seal under a wide range of operating conditions

These metallic "O-Rings" resist pressures as high as 20,000 pounds per square inch and will withstand temperatures limited only by the physical properties of the metal. The same rings can be used again and again. They have proved successful in high-compression Diesel engines, air compressor and vacuum equipment, fuel and exhaust systems, retractable under-carriages, and other hydraulic applications.

The standard rings are of stainless steel or of mild steel, cadmium- or nickel-plated. They are available in sizes ranging from 11/16 inch to 40 inches outside diameter, varying by increments of 1/16 inch.

LATEST DEVELOPMENTS IN *Shop*

Weight-Balancing Milling Machine for Automotive Connecting-Rods

The Motch & Merryweather Machinery Co., 715 Penton Bldg., Cleveland 13, Ohio, has developed a new weight-balancing milling machine in cooperation with the Toledo Scale Co. of Toledo, Ohio. This machine is designed to remove enough metal from each end of a connecting-rod to keep the balance of the rod within 2 grams. The machine is equipped with a reciprocating table which rotates through an angle of 180 degrees and carries two sets of work-holding fixtures; two opposed special quill type milling heads, mounted on hardened ways; and a Toledo scale unit, housed in a floor-mounted cabinet which is positioned at right angles to the machine.

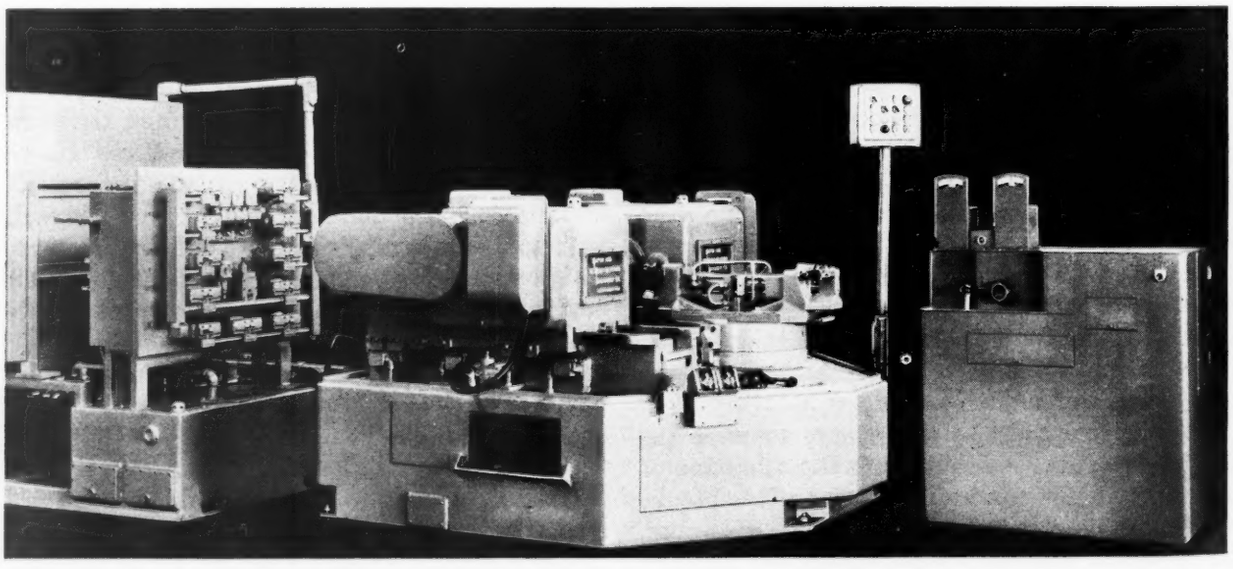
To start the cycle, an overweight connecting-rod is placed on the scale unit, where each end is individually weighed about the fixed center of gravity and the amount of overweight electrically recorded at the machining unit. After being weighed, the connecting-rod is placed in the open work-holding fixture on the rotary index-table.

The cycle button is then pressed, causing the index-table to rotate through 180 degrees to the operating position, where it is located and clamped. The two milling heads are fed by rapid traverse to the piece and stop, while the locating probes advance until they contact the connecting-rod. The milling head quills are then fed forward with the probes and continue to advance until a sufficient amount of metal has been removed from each end of the connecting-rod to give it the correct balancing weight.

The amount of quill advance is determined by a positive stop, preset by the overweight indicated on the scale unit. When stock removal is completed, the milling quills and probes retract, and the milling heads are returned by rapid traverse to the starting position. The index-table then rotates 180 degrees, the work-holding fixture is unclamped, and the operator removes the balanced piece.

During the machining cycle, the operator places the next overweight rod on the scale unit, which transmits the correct data to the milling head unit, where the positive mechanical stops are automatically positioned. Immediately following the weighing, the operator loads the free work fixture with the weighed rod.

The heavy-duty milling heads can utilize up to 10 H.P., and carbide or high-speed steel cutters can be employed. The milling heads are of the single-speed type; however, speed changes can be made by means of change-gears, which are easily accessible. The



Weight-balancing and milling machine for connecting-rods, brought out by Motch & Merryweather Machinery Co.

Equipment

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on Market

Edited by FREEMAN C. DUSTON

normal production rate is 320 pieces per hour, but the cycle of the machine can be arranged for higher rates of production to suit the skill of the operator.

The movements of the milling heads, and of the probes and milling head quills, are actuated by hydraulic cylinders. The rotating of the index-table and clamping of the work-holding fixtures are also accomplished hydraulically. An external hydraulic tank, with motor, pump, and control panel, is regular equipment. All moving parts are automatically lubricated.

Globe Hand Screw Machine

The high-speed, high-precision hand screw machine here illustrated has been designed primarily for secondary operations by Globe Heat-Seal, Inc., 3380 Robertson Blvd., Los Angeles 34, Calif. It has a swing of 10 inches. The large spindle, which is 1 7/16 inches inside diameter, is ground to a No. 5 Morse taper, providing maximum collet capacities of 1 inch for the bar type and 1 3/8 inches for the spindle-nose type of collet chucks.

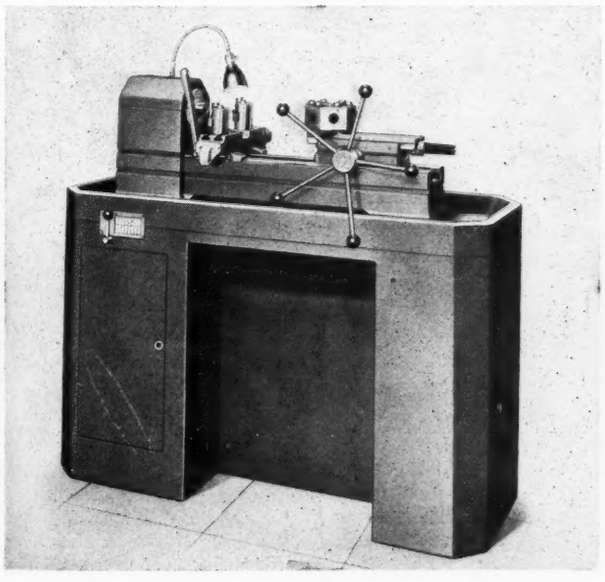
Tapered roller bearings sealed in the head assure a high degree of accuracy at both high and low speeds. The new 40 1/4-inch streamline bed is cast in one piece of high-chromium iron. The ways are 6 inches wide, and are hardened and ground. Length of bed to headstock is 31 1/2 inches, and length of working area from nose of spindle to face of turret is 18 7/8 inches.

Power drive is through a four-position quick-change gear-box, employing dual V-belts and two-step cone pulleys. Through the use of a two-speed, reversible 1-H.P. 1800- to 900-R.P.M. motor, sixteen speeds are available, ranging from 184 to 3796 R.P.M. The motor is of the instantly reversing type.

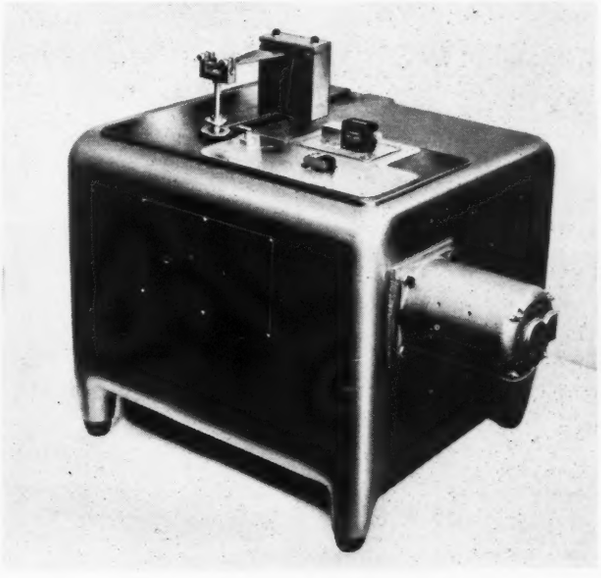
The turret is a new self-indexing hexagonal head type. The rack and pinion operated cross-slides are equipped with two adjustable steel toolposts. Tapered wedges for cutter adjustments and an adjustable stop are provided.

New Baldwin-Sonntag Fatigue Testing Machine

A new model of the Baldwin-Sonntag SF-2 fatigue testing machine has been added to the line of the Baldwin - Lima - Hamilton Corporation, Philadelphia 42, Pa. This machine is a table model—the smallest of five standard models which cover a range in alternating force capacity of from 25 to 10,000 pounds or from 50 to



Hand screw machine announced by Globe Heat-Seal, Inc.



Baldwin-Sonntag fatigue testing machine

20,000 pounds in one direction only. Maximum travel of the loading yoke is 1/2 inch, and the testing speed is 1800 cycles per minute.

Simulated service tests of small parts can be made on the new machine, whereas the original model was limited to sheet-metal specimens. An accessory preload attachment, which can be incorporated in the machine if desired, permits applying a preload in either the up or down direction. Any pulsating load can be superimposed on a static preload within the capacity of the machine.

The machine is driven by a 1/4-H.P. synchronous motor, has a dial load indicator graduated in 0.125-pound increments, and is equipped with a cycle counter. The new design provides a cage guided by flexure plates which absorb horizontal components of centrifugal force, together with a tension-compression spring for inertia-force compensation. Within the cage is an eccentrically mounted mass driven by the motor through flexible couplings. The mass is on the end of a micrometer screw by means of which the dynamic load is varied. A scale on the cage indicates the centrifugal force produced by the revolving mass. Overall dimensions of the machine are 19 1/4 by 25 by 21 3/4 inches.

Lake Erie Die-Casting Machines

The Lake Erie Engineering Corporation, 170 Woodward Ave., Buffalo 17, N. Y., is introducing an improved line of die-casting machines that incorporate two exclusive Lake Erie features, the "wedge cam toggle" and the "Pressure-Pac" injection unit.

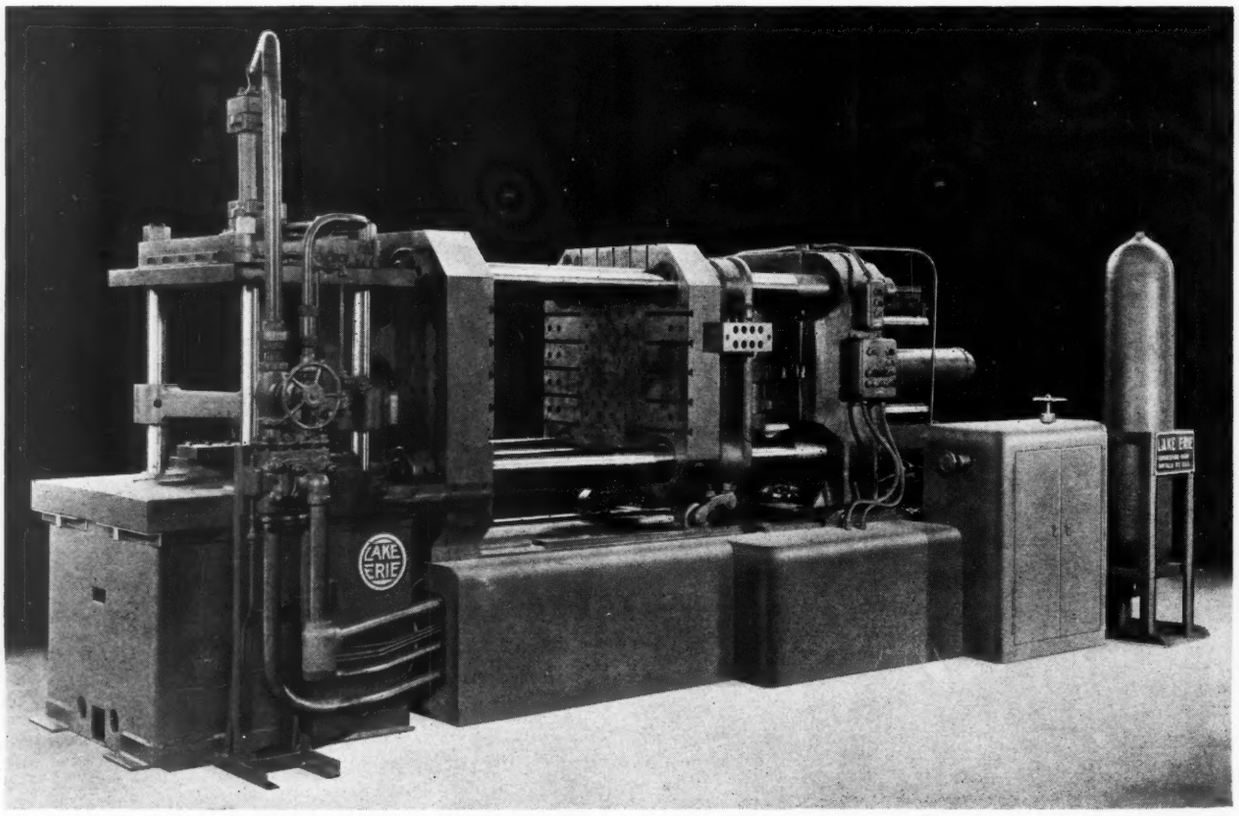
The "wedge cam toggle" is a self-compensating toggle clamp that automatically takes up clearances in the dies produced by contraction and expansion of the molds during production or shutdown periods, and at the same time, engages and disengages easily without binding. This is accomplished by a circular cam contact surface, together with rolls that guide the toggles during engagement and disengagement.

Introduction of the "Pressure-Pac" injection unit has resulted in denser castings, since this unit provides the pressure required to eliminate porosity at the time of solidification. The standard "Pressure-Pac" unit is arranged for a 2 to 1 pressure increase, but special units can be designed for higher ratios. The new line of die-casting machines is available in ten models, with capacities ranging from 100 to 1000 tons, for casting all the usual non-ferrous metals and alloys.

Constan Carbide-Tool Grinder

H. E. B. Machine Tools, Inc., 341 Madison Ave., New York 17, N. Y., distributors in the United States and Canada for Moteurs Constan of France, have announced that a new Type 178 Constan carbide-tool grinder is now available. The table of this machine runs on ball bearings, and incorporates developments resulting from an extensive research. All types of carbide tools, however complicated their profile, can be ground on the new machine without any special attachments. An attachment is available, however, to facilitate grinding carbide inserted-tooth milling cutters.

The machine is suitable for grinding single-point tools, both for lathes and planers. The design



Improved die-casting machine of new line introduced by Lake Erie Engineering Corporation

Constan carbide-tool grinder introduced in this country by H.E.B. Machine Tools, Inc.

also facilitates grinding chip-breaker grooves. A universal ball-and-socket vise, combined with an inclinable table, permits the tool to be readily clamped in any position. Compound angles are easily read, and constant clearance angles are obtainable on tools having radii or complicated profiles.

The wheel-head consists of a motor unit carrying a diamond wheel at each end—one for roughing and one for finishing. The built-in coolant system sprays coolant out through holes in the center of the wheels by centrifugal force. Wheels are raised or lowered by a two-speed handwheel, giving an extremely sensitive control. A radius setting gage is provided, as well as graduated dials for positioning the tool.

Diamond Milling Machine

The Diamond Machine Tool Co., 3429 E. Olympic Blvd., Los Angeles 23, Calif., has announced a new milling machine, designated the 22M, which is claimed to have the rigidity, precision, and capacity of far larger and costlier machines. It has a longitudinal travel capacity of 14 inches; a maximum vertical travel from center of spindle to table top of 15 inches; and a cross traverse of 5 1/2 inches.

The full table working surface is 5 3/4 by 24 inches. Offset handles are designed to facilitate operation with a vertical head, and spring-loaded dials make quick settings possible. There is an automatic kick-off for the power feed. The motor drive is designed for standard NEMA type motors.

Unground Hobs Made to Close Tolerances

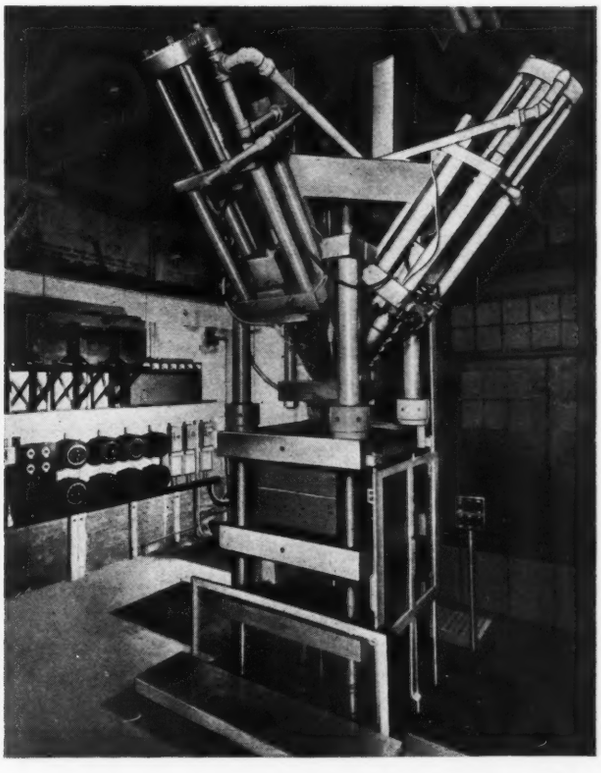
The Michigan Tool Co., 7171 E. McNichols Road, Detroit 12, Mich., announces that it is now manufacturing unground hobs that are held to close tolerances by the use of a new process. The company claims that this process makes it possible to use unground hobs today in many applications where only ground form hobs were formerly considered suitable.

Hobs made by the new process —both single-thread and multiple-thread types—are said to be no higher priced than "accurate unground" hobs previously manufactured by the company, and represent a considerable saving over the ground form hobs where they can be used.

Worcester Giant Size Plastics Molding Machine

A vertical molding machine of giant size has been developed by the Worcester Moulded Plastics

Milling machine of improved design announced by the Diamond Machine Tool Co.



Giant size plastics molding machine developed by Worcester Moulded Plastics Co.

Co., Worcester, Mass. This new machine is said to have 25 per cent more molding capacity than other machines of its type.

Four huge pre-plasticizing units preheat the plastic material to provide better flowing properties. This, together with 25 per cent greater locking pressure on the dies, permits the molding of pieces in larger sizes than previously possible.

Magna Universal Drilling Machine

An entirely new type of drilling machine called the "Magna Drill" is being produced by the Magna Engineering Corporation, Menlo Park, Calif. This machine is designed to make possible quick, accurate set-ups for simultaneous multiple drilling in more than one plane. Basically, it consists of a standardized, individually powered, adjustable drill head with a mounting system of ground steel tubes and joint castings that permits unlimited flexibility in locating any number of spindles independently of one another, with their axes in practically any plane or angle desired. Each spindle operates individually with the proper rotary speed, correct feed rate, pre-set drilling pressure, and depth limitation for the operation it is performing.

The new drills can be quickly set up for production drilling of work previously handled only by special-purpose machines designed to drill one specific piece. Also, they can be easily reset for work requiring different operations without the necessity of providing special tooling.

Any number of Magna drill heads like the one shown on the machine illustrated in Fig. 1 can be quickly set to drill to the center of a sphere from any point on the surface of the sphere. The heads will perform any operation that is practical to perform on conventional drilling machines and will take any attachment used on such machines. Mechanical or air powered "package" feeds can be mounted directly on the quill front and can be attached or removed in a few minutes.

Magna drill head units have a capacity of 1 inch in cast iron and 3/4 inch in steel with a full 5-inch stroke. The throat is adjustable from 6 1/2 to 14 inches, so that the unit will drill to the center of a 28-inch circle. Each head has its own 1-H.P. motor, with a newly developed gear-belt pulley drive to spindle through the hollow ground steel tubing on which the head and motor are mounted. Clearance is 32 inches under the spindle tip at maximum height. The narrow head design permits drilling on 6-inch centers, but by opposing spindles horizontally, drilling with zero center distance can be attained.

There are no exposed moving parts except the chuck itself. A cam-actuated motor mount gives seven instantly available spindle speeds ranging from 251 to 6860 R.P.M. Feed levers are reversible for right- or left-hand operation. The depth stop is an improved micro-adjustment type with posi-

Fig. 1. "Magna Drill" equivalent in size and power to conventional 17- and 20-inch production drill presses. The drill head can be revolved 360 degrees both horizontally and vertically. The column and base also permit mounting the head horizontally or vertically

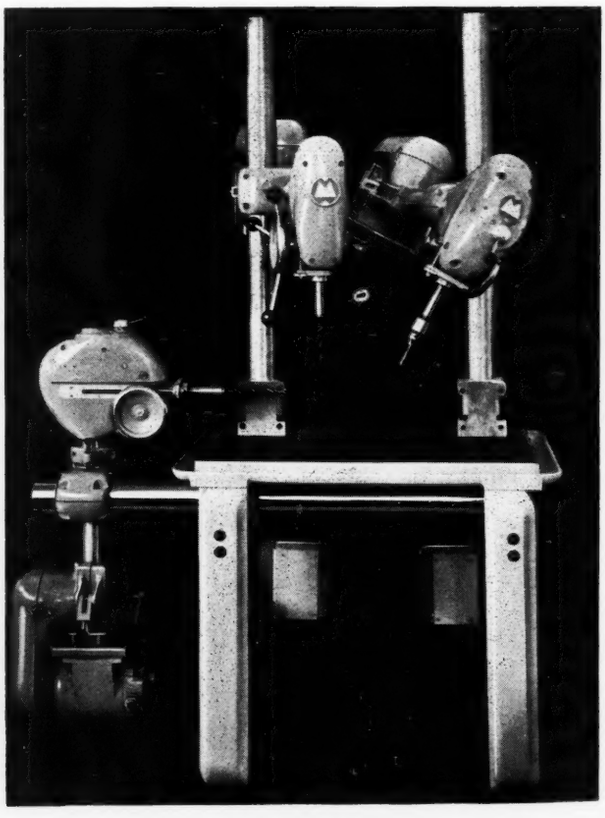


Fig. 2. "Magna Drill" with one horizontally mounted power feed unit at left end of table, a vertical manually fed unit at the rear left end of table, and a vertically mounted power feed unit at the right end, the latter unit being swiveled for angular drilling

tive lock. Maintenance costs are minimized by lifetime lubricated, sealed over-size ball bearings.

Adjustment of the drill head through 360 degrees is facilitated by protractors on movable joints with vernier lines for quick precision set-ups. Columns are 3 1/2-inch ground steel tubing with 3/8-inch walls. The tables are cast iron, surface ground, drilled and tapped top and bottom for mounting heads in a variety of positions. The ends of the table are finished and have dowel-holes for assembling in gangs for multiple drilling or attaching coolant troughs.

The power feed is self-contained. When equipped with solenoid release for multiple drilling, it can also be set for continuous cycling and for manual over-feed to suit the machining requirements. Change-gears for 0.0025, 0.005, 0.008, and 0.012 inch feed per spindle revolution are available, and additional feed ratios can be provided. Drill point pressure is adjustable from 100 to 1000 pounds.

DeVlieg "Spiramatic Jigmil" Precision Boring and Milling Machines

A line of Series B and C "Spiramatic Jigmils" incorporating new developments in the field of precision boring has just been announced by the DeVlieg Machine Co., 450 Fair Ave., Ferndale 20, Mich. A spindle head with automatic transmission and an automatic trip mechanism for the spindle bar feed are outstanding features of these boring and milling machines.

The newly developed spindle head has single helical gears which operate in constant mesh. Spindle speeds are preselected by setting a dial to the desired speed, after which the actual speed change is made automatically by depressing a single push-button. Automatic speed changes from high to low speeds are made smoothly and without shock to the transmission. The speed changing mechanism can be operated with the spindle running in either direction.

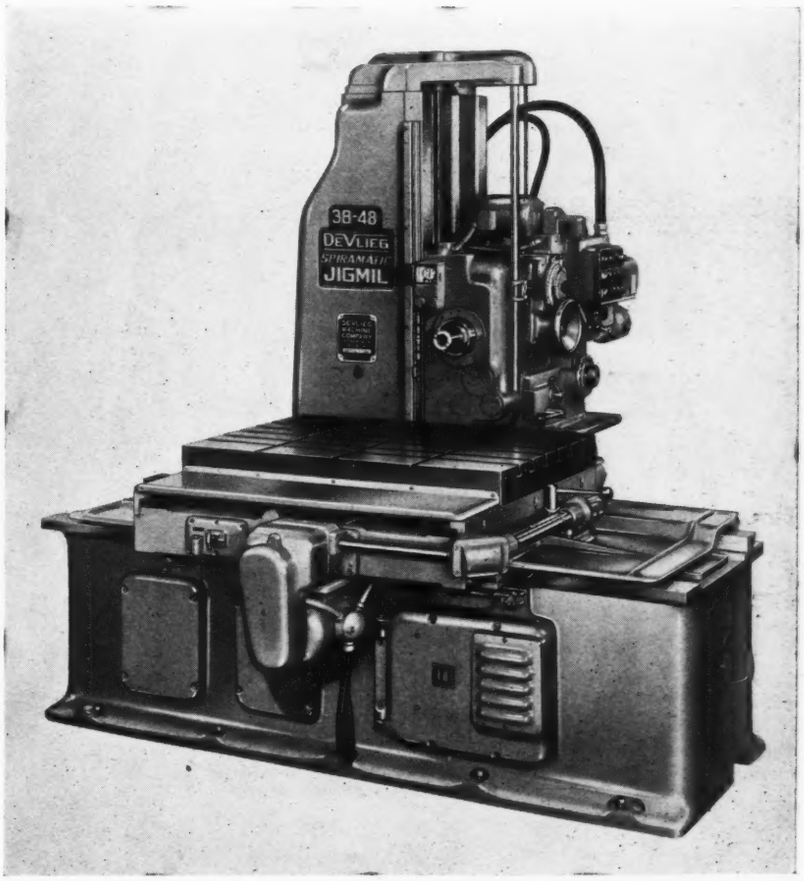
The spindle bar feed unit has an automatic trip mechanism for stopping the bar feed at any predetermined point. This provides a means for accurately controlling the depth of the bar feed when performing counterboring, facing, and back-facing operations. Graduated dials and vernier scales are provided to facilitate establishing the depth of feed and automatically stopping the tool when the desired depth of cut is reached. A rotating turret attachment with multiple stops and trip mechanism is available for production work involving multiple counterboring and facing operations to close limits.

The machines in the new line have all the basic features found in DeVlieg "Jigmils," including means for controlling hole spacing in the work-piece to precise limits of accuracy through the operation of a single push-button; "Duplitrol" system, which can be used in conjunction with the automatic positioning cycle to provide a means for obtaining accurate hole spacing in the work-piece when dealing with repetitive production work; power tool lock for electrically operating a mechanism that locks and releases the cutting tools; and threaded draw-bar rotated by power in hollow spindles.

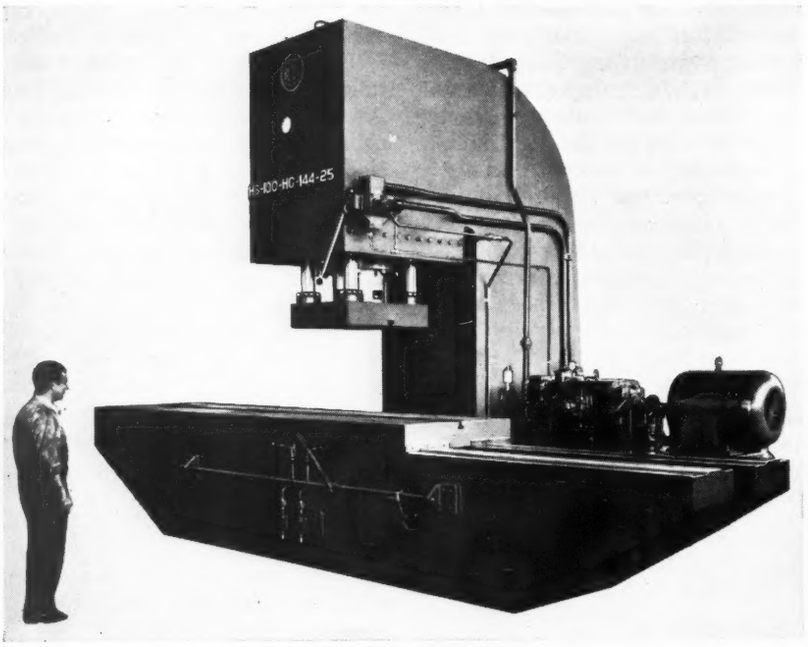
The Series B "Spiramatic Jigmils" for universal applications are designed for all types of precision boring and milling operations, ranging from tool and experimental work to the production of repetitive work without jigs. With suitable equipment, these machines will produce a wide variety of work, such as, machine tool parts, gear-cases, aeronautical parts, component parts for printing presses, textile machinery, etc.

The Series 3B machine, shown in the accompanying illustration, has a spindle bar 3 inches in diameter, a vertical range of 36 inches, and a horizontal range of 48 inches. This machine is also available with a horizontal range of 72 or 96 inches. The Series 4B machines have a spindle bar 4 inches in diameter, a vertical range of 48 inches, and a horizontal range of 60, 72, 96, and 120 inches.

The Series C "Spiramatic Jigmils" are designed specifically for large-area flat work, such as, textile and printing machine side

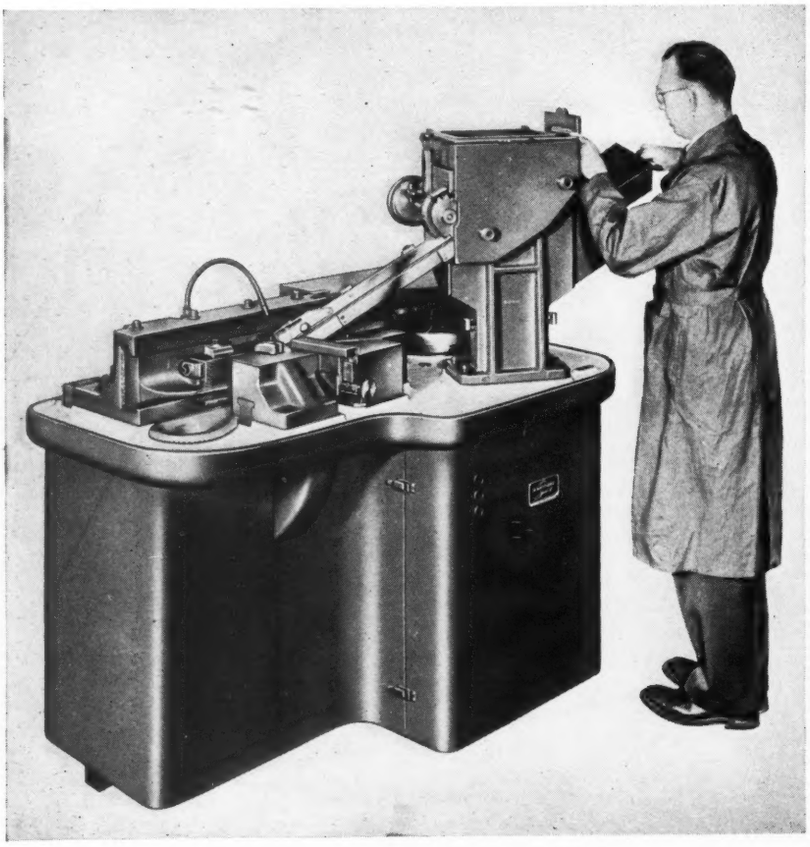


"Spiramatic Jigmil" developed to handle wide range of precision boring and milling operations by the DeVlieg Machine Co.



Bliss hydraulic straightening press with two-dimension positioning by hydraulic system

frames, aircraft wing assembly jigs, etc. The Series 3C machines have a spindle bar 3 inches in diameter, a vertical range of 36 inches, and horizontal range of 72 or 96 inches, while the Series 4C machines have a spindle bar 4 inches in diameter, a vertical range of 48 inches, and a horizontal range of 96 or 120 inches.



Automatic hopper-fed thread rolling machine announced by the Hartford Special Machinery Co.

Bliss Hydraulic Straightening Press

Development of a highly versatile hydraulic straightening press featuring fast two-dimension positioning of the work is announced by the E. W. Bliss Co., Canton, Ohio. Quick positioning is obtained by hydraulic systems, which move the press bed from side to side and the plunger assembly from front to back at the touch of a lever. This allows a number of blows to be struck at different places on a piece without changing the setting on the press table.

Speed of operation is further increased by the quick advance and return feature of the hydrodynamic circuit, which allows the slide to advance rapidly to the work, slow up while doing the actual straightening, and then return to the "up" position rapidly.

Operation of this 100-ton press is simple. Levers on the front of the bed control the front to back motion of the ram, the side to side motion of the bed, and the conventional up and down motion of the slide. Once the work is positioned under the ram, a fourth lever located on the front of the press crown, locks it in position and transfers the output of the pump to the system controlling the vertical motion of the plunger.

Hartford Automatic Thread Rolling Machine

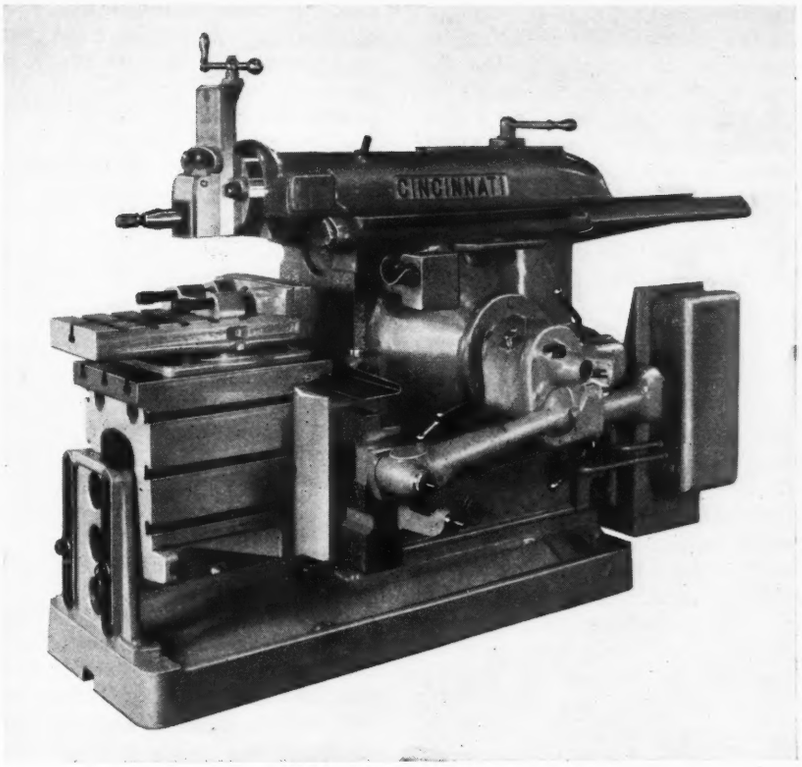
The Hartford Special Machinery Co., Hartford 12, Conn., has announced a new automatic thread rolling machine of larger capacity than previous models. This new machine, designated A-312-14, will roll machine screws from size 6 to 5/16 inch in diameter and thread lengths up to 2 1/2 inches. Production is at the rate of 80, 100, 120, or 140 pieces per minute, depending on the size of the screw to be rolled. At the end of the operation, the screws are automatically ejected.

The machine is 62 inches in length by 63 1/2 inches high, and requires a floor space of 4 by 6 feet. The height from the floor to the hopper is 53 inches. Simple, rugged design, easy set-up, and accessibility of working parts are features of the new machine. It is equipped with a 5-H.P. motor, starting switch, and automatic safety overload cut-off.

Cincinnati Shaper with Electromagnetic Clutch and Brake

The Cincinnati Shaper Co., Hopple & Garrard Sts., Cincinnati 25, Ohio, has announced that an electromagnetic clutch and brake will now be standard equipment on all sizes of Cincinnati shapers at no increase in prices. The new clutch and brake permit instant starting and stopping with a finger-tip control lever. The ram can be positioned quickly and accurately for setting tools by the instant action of the clutch and brake. The single control, placed in the most convenient position, is said to save up to 30 per cent of the total time previously required for some jobs.

The clutch and brake operate without "grabbing" and are designed for powerful and smooth action. No adjustment is required during the life of the friction surfaces, which is estimated to be as much as fifteen years under ordinary operating conditions. Torque is said to remain constant throughout the operating life of the clutch and brake.



Shaper equipped with new electromagnetic clutch and brake built by Cincinnati Shaper Co.

Multiple Gaging Machine for Automotive Crankshafts

Multiple gaging of the critical dimensions of an automotive crankshaft can be rapidly accomplished on a new machine developed by the Sheffield Corporation, Dayton 1, Ohio. This machine is designed to check main bearings for size and taper; pilot-hole diameters; flange diameters and run-out; thrust bearing faces; keyway locations, etc. The part to be gaged is placed in a loading cradle and elevated above the gaging units for protection and ease of loading. Then a hydraulic device, actuated by a hand-lever, automatically lowers the part into the gaging position.

Up to thirty-four or more dimensions can be gaged and read simultaneously by a glance at the float graph, or "Airchart" formed by the float positions in the "Precisionaire" columns of the gaging machine. The part is easily revolved on rolls to gage it for concentricity and run-out. A hand type Airsnap is used to simultaneously gage the crankpins for

Sheffield multiple gaging machine for automotive crankshafts

diameter and taper in three places on the journal. After the gaging operation is completed, the hydraulic device raises the part from the gaging position.

All gaging anvil surfaces are of tungsten carbide. In addition to rapid gaging, the new machine is said to have the advantage of eliminating eye strain, close concentration, and the necessity of remembering figures. An indicator panel, attached to the front of the instrument, clearly shows in diagrammatic form all dimensions and conditions to be gaged.

Cross Transfer-matic for Boring and Facing Flywheel Housings and Cylinder-Block Assemblies

A Transfer-matic machine for boring and facing flywheel housings and cylinder-block assemblies has recently been built for a leading car manufacturer by The Cross Company, Detroit 7, Mich. On this particular machine, the work automatically travels from an incoming conveyor to the machining station and from there to an outgoing conveyor. With this arrangement, only one unskilled operator is needed to produce eighty-one pieces per hour.

The machine bores the transmission hole and faces the transmission face concentric and square with the crankshaft bore. "Down" time is greatly minimized by the use of pre-set tools, which facilitate tool changing operations.

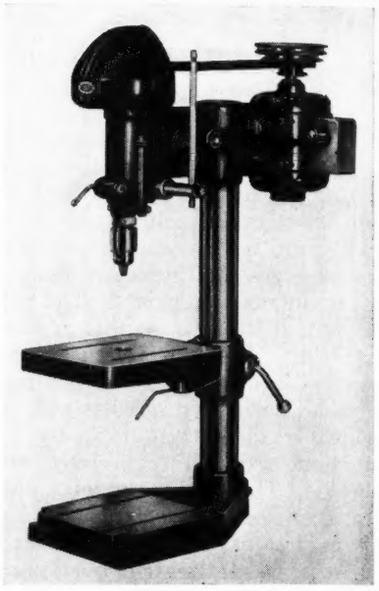
Among the features incorporated in this new Transfer-matic are automatic lubricating, automatic power-operated locating and clamping, and automatic balancing for the cross-facing slides. Other features include individual hydraulic feeds for boring and facing, construction to J.I.C. standards with stranded wire, and hardened and ground ways.

Boice-Crane Drill Press

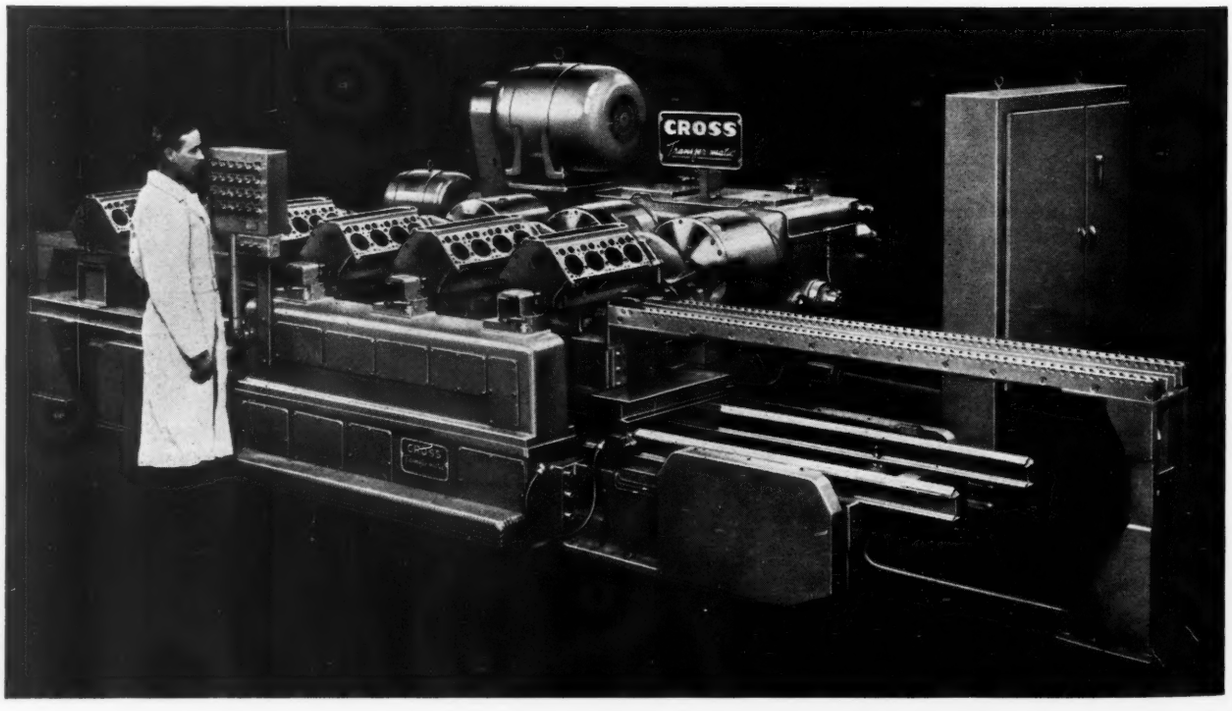
A new development in drive-belt alignment devices is one of several features of the 1650 series drill presses recently placed on the market by the Boice-Crane Co., 959 Central Ave., Toledo 6, Ohio. This two-way drive tensioning device is designed to assure accurate drive-belt alignment at all times and to permit the belt tension to be instantly released for quick, easy changing of speeds.

All parts of the six-tooth splined drive, including the pulley drive sleeve, are made of steel and designed to insure quiet running and long life. A new type guard covers the pulley spindle, which runs in four heavy grease-sealed ball bearings.

Other new features include a massively designed head and positive, easy operating quill and column locks. An extra wide selection of speeds is available in two ranges—500 to 5500 R.P.M., and 425 to 3340 R.P.M.



Drill press with drive-belt alignment device, made by the Boice-Crane Co.



Transfer-matic built by The Cross Company for boring and facing flywheel housings and cylinder-block assemblies

High-Speed Metal Planer for Beveling Steel Plate

A 40-foot open-throat planer designed primarily for use in beveling steel plate prior to welding has been built by the Baldwin-Lima-Hamilton Corporation, Philadelphia 42, Pa., for the Wyatt Metal & Boiler Works, Houston, Tex. The planer has a maximum carriage speed of 45 feet per minute. With 1/8-inch feed and carriage travel of 15 feet per minute, it can remove 34 cubic inches of material a minute from mild steel plate 1 1/2 inches thick. Although designed to handle material 40 feet long, the control of clamping jacks has been sectionalized for the widest possible range of plate lengths. The over-all length of the planer is 63 feet.

The twenty-seven jacking cylinders, operated by compressed air at a pressure of 90 pounds per square inch, are capable of exerting a total clamping pressure of 270,000 pounds. They are arranged in six banks, of four each, and one of three, so they can be worked in groups or all together to clamp any length plate.

The carriage driving screw is drip lubricated for its full length, and operates in tension, whether cutting to the right or left. Placed under a slight overhang of the bed at the front, the screw is protected against falling chips and dirt from the planing operation. Cast-iron cradles along the frame support the screw throughout its length, and anti-friction bearings at the ends take care of the thrust load. The carriage rides on renewable hardened steel wearing plates fastened to the bed.

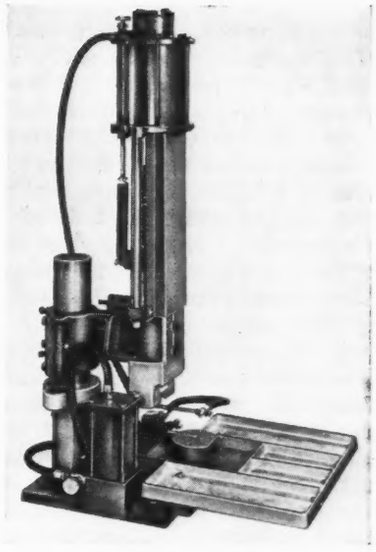
The tool carriage is provided with an operator's platform with start, stop, reverse and jog controls. In operation, the motor is slowed down and reversed through dynamic braking at the end of each stroke. In case of power failure near the end of a stroke, inertia of the carriage and revolving parts cannot damage the planer because sufficient clearance is provided to permit the driving nut to move beyond the screw thread before the carriage touches the planer frame.

The carriage has two tool-heads, and the cross-slides are mounted on swivel plates. Thus the clapper-boxes, mounted on the cross-slides, can be swung through an angle of 30 degrees. To prevent drag on the back stroke, the tool-holders are lifted by solenoids.

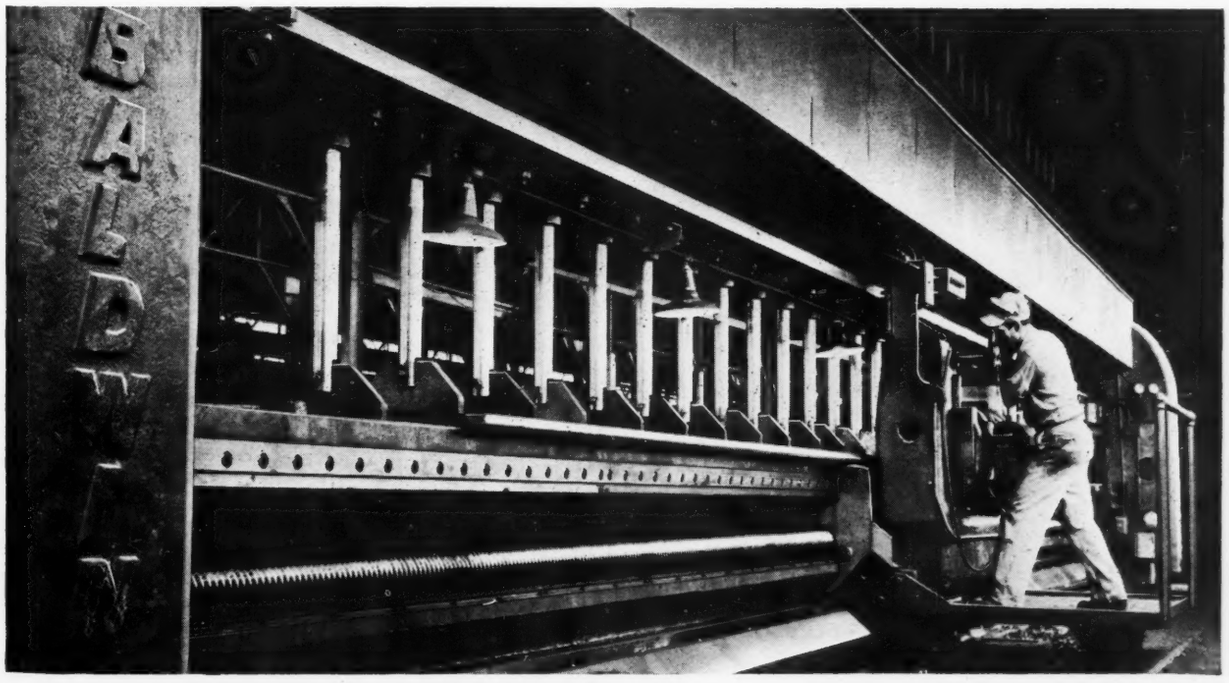
Winter Improved Staking Press

An improved design of the staking press made by Winter Products, Inc., Box 3112 Barnum Station, Bridgeport, Conn., has been announced. New features are said to permit an increase of 50 per cent in operating speed. This Model RR-6B air-operated press is capable of making 100 or more strokes per minute, the maximum rate depending on type of work and skill of the operator.

The press has a built-in quick-exhaust air valve and a new, simplified, air-ejection system to remove work automatically from the lower die. Like earlier models, it is a bench-mounted unit designed



Staking press with slide feed announced by Winter Products, Inc.



Planer built for high-speed beveling of steel plates by the Baldwin-Lima-Hamilton Corporation

for light staking, forming, and other secondary press work in which speed, precision, and low operator fatigue are important factors. It is capable of delivering an accurately controlled impact of from 0 to 12,000 pounds, or a squeeze up to twelve times the air-line pressure. The stroke can be set for 1 or 2 inches. A two-hand safety control provides protection for the operator.

The Model 300 slide feed shown mounted on the press in the operating position is another new product of the company. Features of this feed include built-in hydraulic control of slide speed; stroke of 2 or 3 inches, which can be adjusted as desired; adjustable air blow-off for ejecting work; safety guard designed to completely protect the operator; and an attached small-parts tray.

Walker-Turner Drill Press

The Walker-Turner Division, Kearney & Trecker Corporation, Plainfield, N. J., announces a redesigned line of 15-inch drill presses. The new drill presses have a 1/2-inch capacity in cast iron, and will drill to the center of a 15-inch circle. Spindle travel is 6 or 4 1/4 inches.

The 6-inch spindle travel model, which is completely new, incorporates a calibrated depth gage and a micrometer type depth stop. All have an enclosed motor switch housing, built into the head casting. Belt guards are constructed of light-weight, steel stampings.

One of an extensive line of Walker-Turner drill presses

Features include six-spline spindle, independently mounted spindle pulley, and one-piece head castings. Four speeds ranging from 600 to 5000 R.P.M. are available. A pulley for slower speeds can be supplied if required. These machines are available in bench, floor, and multi-spindle models. There are seventy-two models.

G-E Fractional-Horsepower Motors of New Design

Entirely new design and structural features are embodied in a line of fractional-horsepower motors just announced by the General Electric Co., Schenectady 5, N. Y. Some of the motors in this "Form G" line weigh 51 per cent less per horsepower than the models they replace, and are considerably smaller in size. At the same time, their range of applications has been greatly broadened and their appearance modernized.

The motors available in the new line include open drip-proof and totally enclosed fan-cooled models in Types K (polyphase), KC (capacitor-start), KH (split phase), and KOP (permanent split capacitor). Fig. 1 shows a 1/2-H.P. open drip-proof, capacitor-start motor with all-angle sleeve bearings and resilient base mounting, while Fig. 2 illustrates a totally enclosed fan-cooled, capacitor-start, Type KC, 40-frame diameter motor having ball bearings and solid base mounting.

This line of motors has a wide range of applications on pumps, fans, blowers, compressors, office and home appliances, motorized tools of all sorts, etc. The design incorporates a completely new insulation system, developed especially for this line of motors. It consists of a special nylon material, scientifically combined with Formex wire and Glyptal varnish,

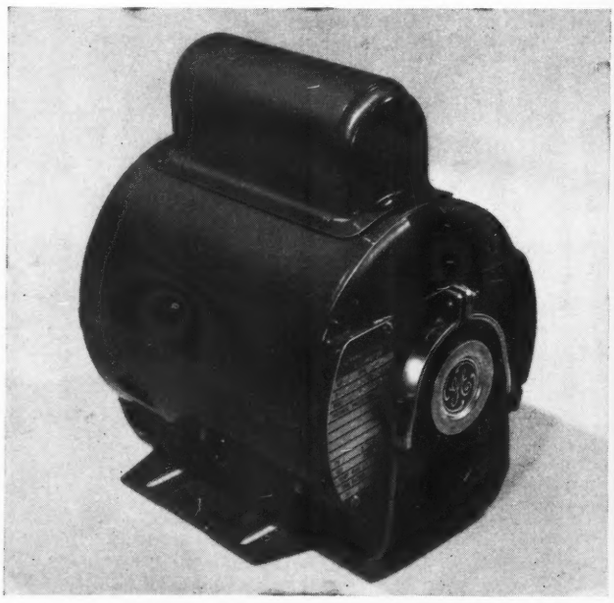


Fig. 1. Open, drip-proof, capacitor-start, 1/2-H.P. motor of new "Form G" line announced by General Electric Co.

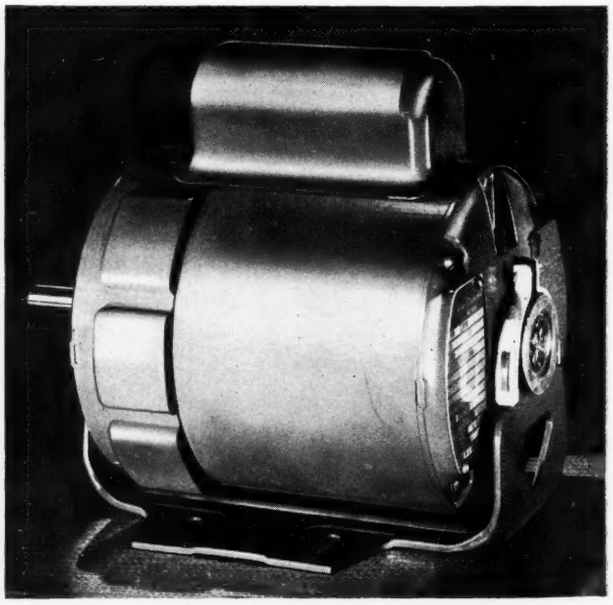


Fig. 2. Totally enclosed fan-cooled capacitor-start, fractional-horsepower motor—another model in "Form G" line

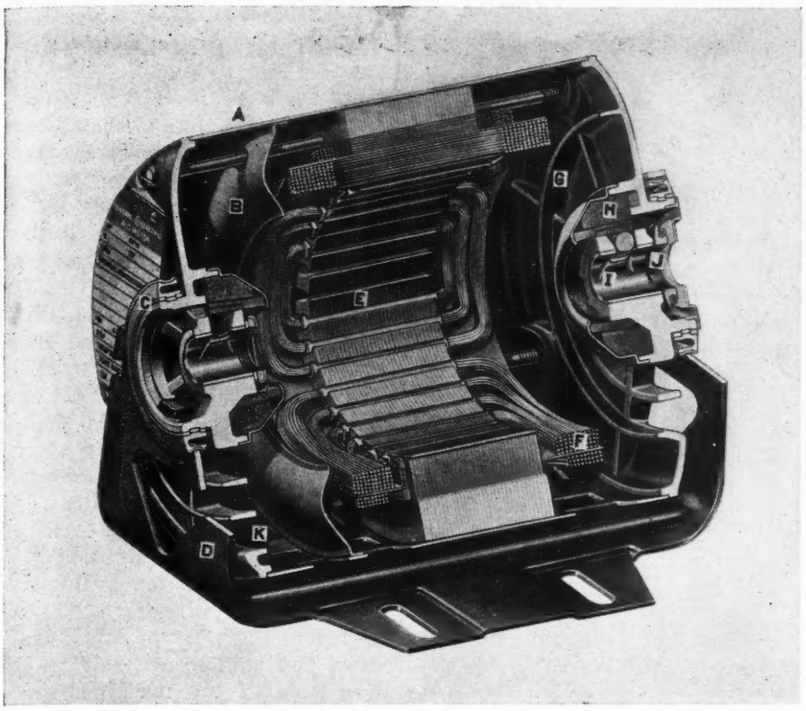


Fig. 3. Cut-away view of typical motor in new G-E line, showing features of construction

a feature that results in longer motor life.

Outstanding features of a typical "Form G" motor are shown in the cut-away view Fig. 3. The light-weight, strong, precision machined steel shell *A* is designed to maintain true alignment, thus insuring long motor life and free running qualities. The surface of the shell is phosphatized to provide corrosion protection. There is a baffle ring *B* that separates incoming and outgoing ventilating air on nameplate end of motor. Vibration is isolated and quiet operation obtained by a double-bonded resilient ring *C* pressed on the bearing nose. The steel cradle base and locking latches *D* maintain shaft alignment and strongly support the all-position mounting. This construction, which is used on both solid and resilient mountings, permits rotation of motor to suit all requirements.

Stator core *E* is of welded construction, finished to close tolerances and firmly fixed in the expanded shell. The unified, extra strong insulation system *F* is resistant to heat, aging, and other normal motor deteriorants. Flat, disc type end shields *G* are provided, which are of light weight, have rabbet and bearing surfaces in the same plane, and support motor loads easily.

Felt wicks *H* in the oil reservoir were selected for maximum oil retention and delivery of oil to bearings. The sleeve bearings *I*, bored to a mirror-like finish, and the lubrication system were designed for operation in any position. An external oil thrower *J* prevents oil from escaping along the shaft. Free movement of cooling air is provided for by ventilating openings *K*.

Referring to Fig. 4, the aluminum rotor winding *L* is made by a vacuum pressure casting process that is said to be new to the motor industry. The process produces a denser winding that results in more uniform performance. Large ventilating fins, cast integral with the winding, provide the maximum amount of air flow within a relatively small space. The easily removed locking device *M* holds the rotor in place. This unique device, together with the thrust washer assembly, maintains correct end play, absorbs moderate thrust loads, and needs no maintenance. Pressed on the shaft is a centrifugal mechanism *N*, designed to maintain correct alignment and assure proper contact spacing for smooth, positive action.

Improved Unit Pillow Block

An improved Hess-Bright unit pillow block with a lubricant-retaining Fairprene red seal has been announced by S K F Industries, Inc., Philadelphia 32, Pa. Practically frictionless wiping action of the seal against the inner bearing ring is a major feature of this unit. Other features include rotating flingers designed to exclude dirt, and a collar with setscrews arranged to facilitate installation. A spherical outer ring compensates for misalignment.

The new pillow block was designed for light-power take-off units and jack shafts. It is adapted for a wide range of applications in conveying equipment and textile and agricultural machinery. These pillow blocks accommodate shafts ranging from 1 3/16 to 2 15/16 inches in diameter.

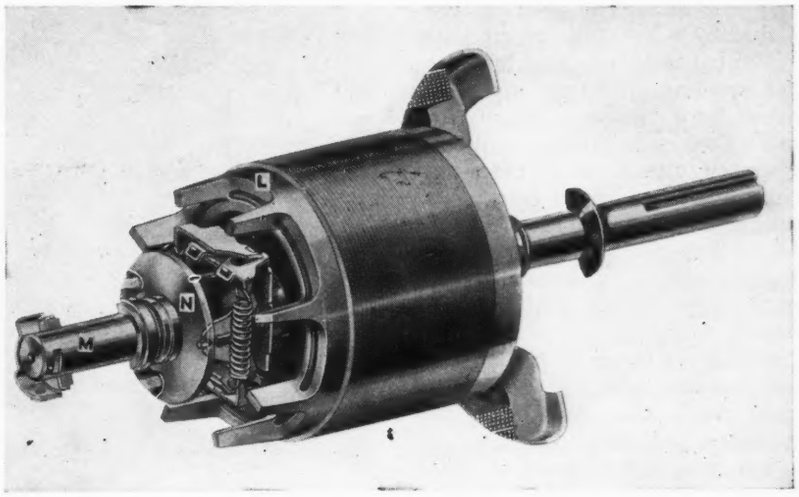
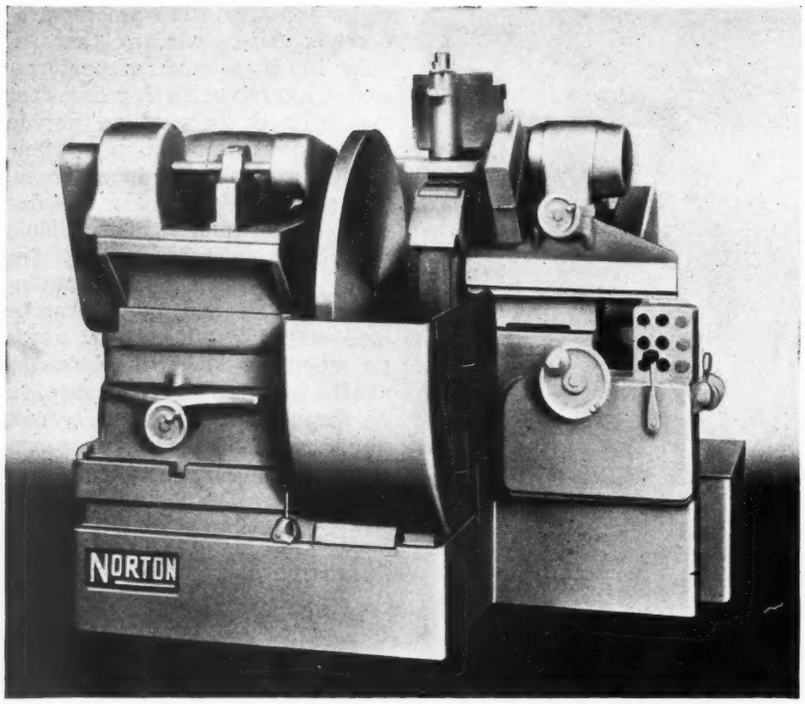


Fig. 4. Assembly view of rotor used in motors of type shown in Fig. 3



Machine for grinding jet-engine compressor wheels placed on the market by the Norton Co.

Norton Compressor Wheel Grinding Machine

Special features designed to simplify grinding operations on jet-engine compressor wheels or similar work have been incorporated in a new machine built by the Norton Co., Worcester 6, Mass. The work-head spindle of this machine is designed for convenient mounting of faceplates, chucks, or other work-holding fixtures. The machine will handle work up to 42 inches in diameter. The work-head is mounted on a swivel table, and has longitudinal and cross adjustments. The work-head table also has longitudinal power traverse with automatic reversals furnished by a hydraulic motor unit.

Manual tasks required in external grinding operations are minimized by a timer-controlled automatic feed cycle. This permits the operator to tend two or more machines. A handwheel feed mechanism is also provided. Truing of the external grinding wheel is facilitated by an automatic wheel-guard type truing device. This device is operated by a push-button with minimum disturbance of the machine settings, and can be used while the work is in the grinding position.

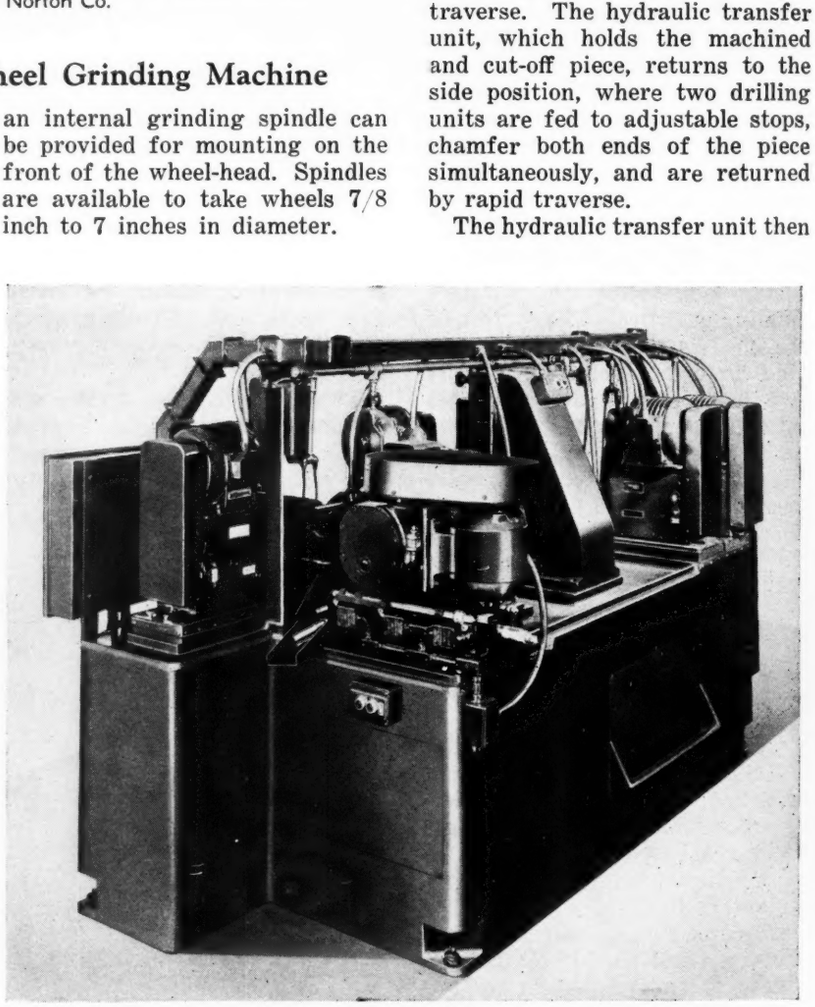
For grinding internal or other surfaces that cannot be reached with the external grinding wheel, an internal grinding spindle can be provided for mounting on the front of the wheel-head. Spindles are available to take wheels 7/8 inch to 7 inches in diameter.

In-Line Transfer Machine for Machining Differential Pinion-Shafts

Differential pinion-shafts can be machined, cut off to accurate length, and finally chamfered at both ends on an automatic transfer machine of the progressive in-line type, built by the Motch & Merryweather Machinery Co., 715 Penton Bldg., Cleveland 13, Ohio. In the particular machine illustrated, solid cold-drawn stock is fed hydraulically to the first station, where the stock is drilled from both sides. At the second station, the drilled hole is countersunk, while at the third and fourth stations, flats are broached on both sides of the stock.

At the fifth station a Motch & Merryweather circular saw head is fed to the work by rapid traverse, and cuts to accurate length a section of the machined stock held by a transfer unit, after which it is returned by rapid traverse. The hydraulic transfer unit, which holds the machined and cut-off piece, returns to the side position, where two drilling units are fed to adjustable stops, chamfer both ends of the piece simultaneously, and are returned by rapid traverse.

The hydraulic transfer unit then



Transfer type machine built by the Motch & Merryweather Machinery Co. for machining differential pinion-shafts

returns to the in-line position of the bar stock, ejects the completed piece into a chute, and receives the next section of bar stock to be cut off.

This machine handles 300 differential pinion-shafts per hour. It will accommodate either regular or extruded bar stock. The stock is held rigidly at each machining station. A basic new principle of design incorporated in the machine permits many different types of operations to be performed on the bar stock prior to cutting it to length.

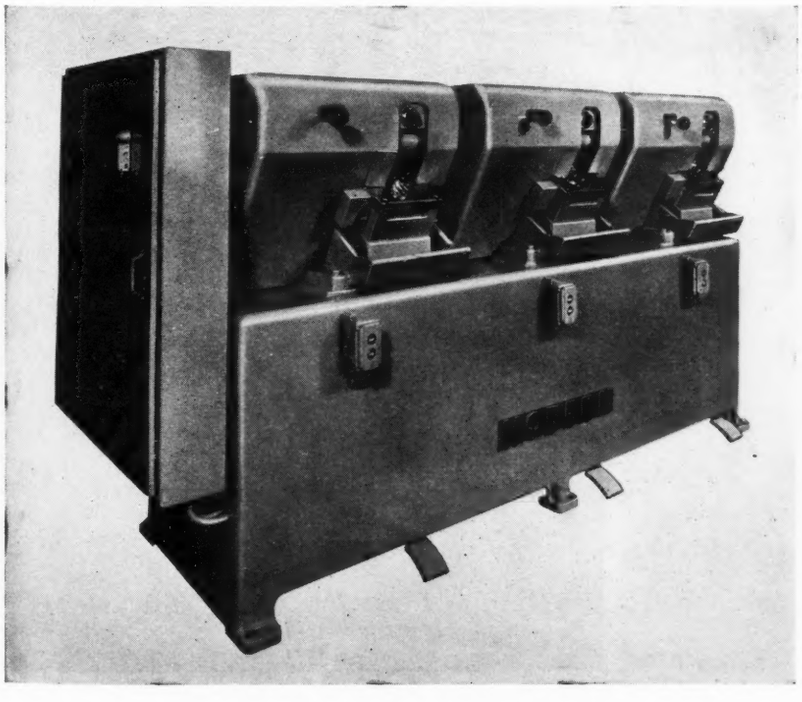
Burring and Chamfering Machines for Hypoid Pinion Teeth

The Modern Industrial Engineering Co., 14230 Birwood, Detroit 4, Mich., has announced a new line of burring and chamfering machines for hypoid pinion teeth. These machines embody a considerable number of advanced features for which patents have been applied.

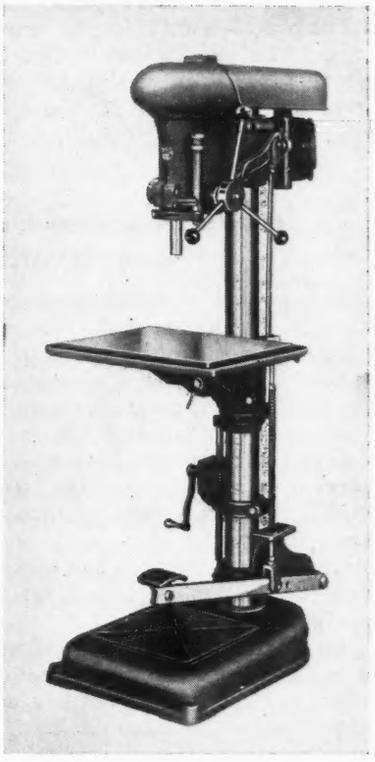
The operations performed include simultaneous chamfering on the acute side of the teeth; removal of burrs and sharp edges on the profile and a considerable part of root on both toe and heel; and, peripheral chamfering on the large end. Increased production capacity is obtained with these machines, the output rate being up to 300 complete hypoid pinions an hour per station for each machine. Among the features are simplified operation, with push-button control and safety interlocks; automatic gaging; long-life tooling designed for minimum "down" time; and simple change-over for pinions of different tooth numbers and diameters. No coolant is required, the cutting being done dry.

The Model 2041 machine illustrated is a three-station "Burr-Master" for simultaneous chamfering of as many as three different hypoid pinions of different dimensions—one at each station. The three stations are identical except for detail tooling assemblies and ratio of change-gears. Each station is independently operated, and is provided with a built-in chip disposal chute.

This machine requires a floor space of 44 1/2 by 92 inches, and has a working height of 40 inches. The height is 52 inches, and the weight about 4000 pounds. Power is furnished by three 1-H.P. 220-440-volt electric motors—one for each station. "Burr-Masters" are also available in single-station and twin-station types.



"Burr-Master" for burring and chamfering hypoid pinion teeth, announced by the Modern Industrial Engineering Co.



Drill press of improved design made by Duro Metal Products Co.

Improved Duro Drill Press

A redesigned 18-inch drill press has just been announced by the Duro Metal Products Co., 2681 N. Kildare Ave., Chicago 39, Ill. Many new features have been incorporated in this drill press to provide extra capacity and ruggedness for handling production jobs. Low first cost, high operating efficiency, and the ability to perform a wide variety of drilling and tapping work are other advantages claimed for this machine.

Major improvements include an alloy steel spindle of larger diameter, precision ground to assure greater accuracy; permanently lubricated precision ball bearings, sealed to safeguard against grit and dust; precision bored bearing seats to insure accurate alignment; massive close-grained head casting to eliminate vibration; depth stop; sturdy cast hinged belt and pulley guard; motor mount with easy adjustments; adjustable feed tension with pin for positive positioning; heavy cast-iron column bracket with locking mechanism, which supports the precision-ground tilting production table; table raising mechanism actuated by miter gears; and 3 1/2-inch diameter column.

The machine has a capacity for drilling 3/4-inch holes in cast iron. The spindle has a No. 2 Morse taper. A speed range of from 450 to 1965 R.P.M. is available. Other specifications include spindle travel 5 inches; distance from base to spindle, 44 1/2 inches; distance from table to spindle, 20 inches; height, 69 inches; table surface, 14 by 18 inches; and weight, 350 pounds.

Baker Machine Designed for Boring and Counterboring Mortar Shells

Boring and counterboring of 4.2-inch chemical mortar shells at a production rate of fifty-six shells per hour can be accomplished with the 30 HO boring machine recently developed by Baker Brothers, Inc., Toledo, Ohio. This new high-speed, heavy-duty machine is of the two-spindle inverted type, utilizing hydraulic feed. It uses No. 6 Morse taper drills, and has provision for the use of pick-off speed change-gears.

An Oilgear hydraulic feed pump is arranged for individual motor drive, and the gear-box is located in the base of the machine. Equipment includes self-contained lubricant pump for gear train and bearings.

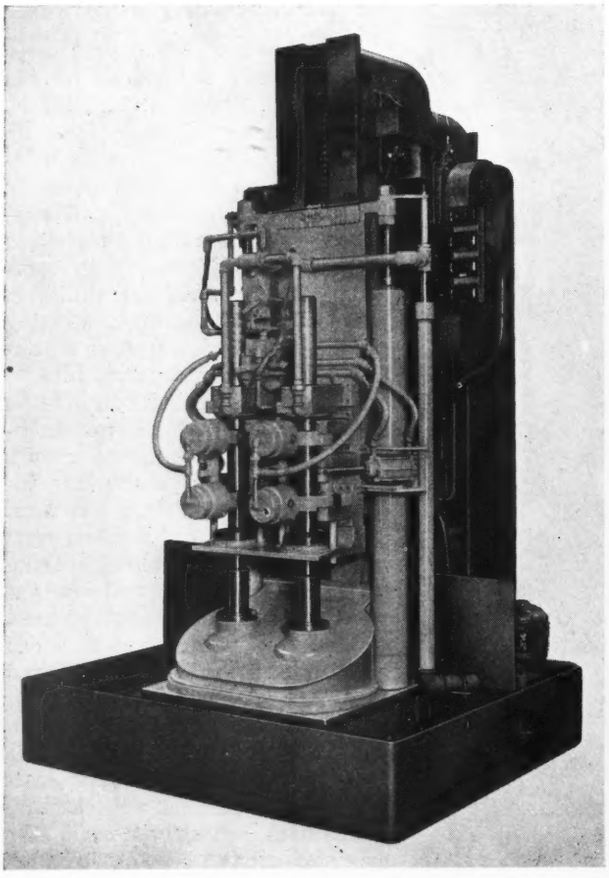
Operations include chucking two shells; locating shells over spindles from fixed V-blocks, one at upper and one at lower end of each shell; boring 3.73-inch hole to a depth of 15 inches; and counterboring 3.74-inch hole to depth of 7/16 inch.

Electro-Hydraulic Check Bench for Testing Brake Light Switches

A new electro-hydraulic check bench has been built by the J. N. Fauver Co., Inc., 49 W. Hancock, Detroit 1, Mich., for checking brake light switches in a large automobile manufacturing plant. This equipment applies 2500 pounds per square inch pressure hydraulically to the switch as a breakdown test and to assure seating of the metallic pressure diaphragm; applies 130 pounds per square inch hydraulic pressure to determine that the switching element makes proper contact; and tests the switching element to make sure that it will carry the same amperage as two brake light bulbs on a 6-volt battery circuit during the contact period of the test. The results of the tests are indicated by three-color panel lights. An actual time-study has shown a sustained production rate of fifteen parts per minute.

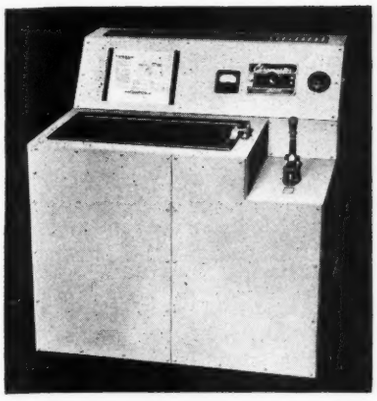
"Chromaster" Hard Chrome-Plating Unit

The 250-ampere "Chromaster" unit here illustrated has just been added to the line of industrial chrome-plating equipment developed by the Ward Leonard Electric Co., Mount Vernon, N. Y. The new unit is designed for chrome-plating small tools or parts in large quantities, or larger sized parts with areas up to 125 square



Baker machine developed for rapid boring and counterboring of mortar shells

Testing bench for checking light switches, brought out by the J. N. Fauver Co.



Ward Leonard hard chrome-plating unit

inches. It is claimed that the life of cutting tools, parts subject to wear, and dies can be increased as much as ten times by using this unit with "Chromasol" plating solution.

Individual floor-mounted plating tank and power unit are designed to minimize installation costs and to conserve floor space. The power unit contains a built-in selenium rectifier, with instrument panel and controls, for accurately regulating the rate of chrome deposit. The average plating time is 3 1/2 minutes for cutting tools.

Wanderer Milling Machine

The Wanderer 1F column type milling machine here illustrated has recently been placed on the market in this country by the Cosa Corporation, 405 Lexington Ave., New York 17, N. Y. This machine has been designed for milling operations on single-part, series, and mass production work.

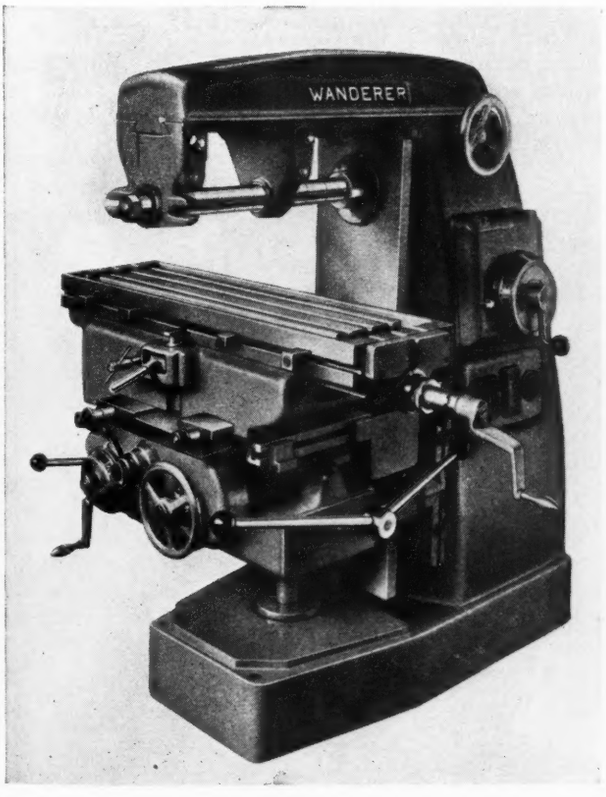
It is made in three models—a plain type; a vertical type, suitable for boring and die-sinking jobs; and a universal type, supplied with a dividing head and other accessories. The spindle head of the vertical milling machine can be turned 45 degrees in either direction, and the spindle has a vertical adjustment of 4 inches. One of the features of these machines is a built-in climb milling attachment.

Specifications of all models are as follows: Clamping surface of work-table, 11 3/4 by 39 3/8 inches or 11 3/4 by 49 1/4 inches; longitudinal table traverse, 28 or 38 inches; number of spindle speeds, sixteen; and number of feeds, nineteen. The drive for this machine is by a motor of approximately 6 H.P.

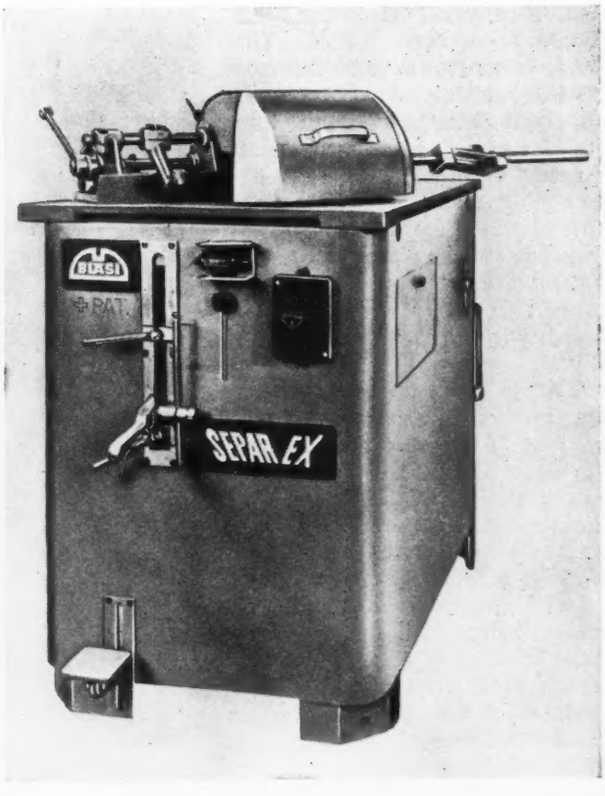
"Separex" Universal Cut-Off Machines

A rigid square base houses the abrasive cut-off wheel and the two-speed (1500 and 2000 R.P.M.) 6-H.P. drive-motor of the "Separex" universal cut-off machine recently introduced by the Cosa Corporation, 405 Lexington Ave., New York 17, N. Y. This machine can be equipped with a fine-tooth saw blade to cut brass or aluminum tubing, or with a section wheel. Practically burr-free cuts can be obtained at the lower speed.

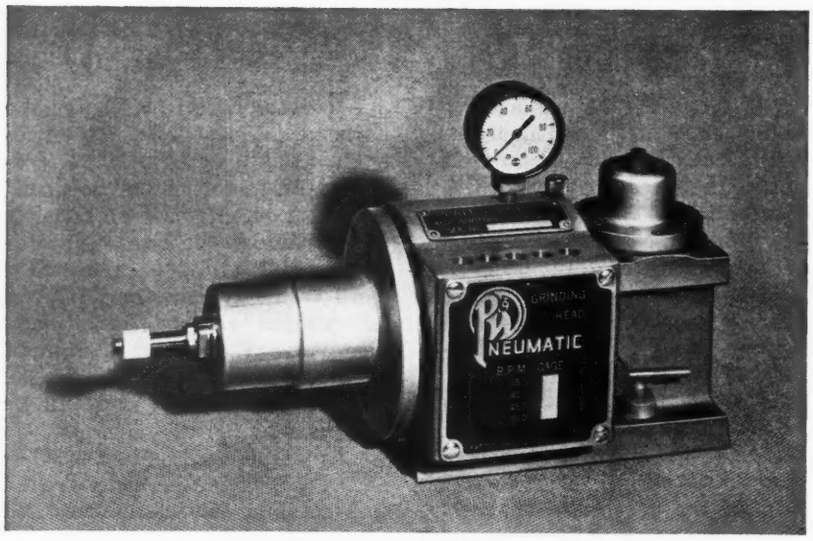
The guide and rapid clamping device bolted to the table top of this machine can be swiveled to permit taking bevel cuts, for which settings can be made by an accurately graduated scale. The wheel feed is either hand- or foot-operated. The cutting capacity is 1 1/2 inches for steel and 2 1/2 inches for brass. The machine, with the wheel in the highest position and all guards removed, lends itself easily to special operations, such as removing risers and flashing from castings. It is also adapted for cutting off plastic and glass tubes. Clamping bolt slots enable special fixtures to be mounted on the machine when required.



Wanderer column type milling machine announced by the Cosa Corporation



"Separex" universal abrasive cut-off machine introduced by Cosa Corporation



Air-driven high-speed internal grinding spindle developed by Pratt & Whitney

Pratt & Whitney Air-Driven Internal Grinding Spindles with Wide Speed Range

The Pratt & Whitney Division Niles - Bement - Pond Co., West Hartford 1, Conn., has developed a new high-speed pneumatic grinding head having a wide speed range with governed speed control. This equipment has been especially designed to enable holes of exceptional accuracy and fine finish to be ground.

Two units are now in production, covering a speed range of 35,000 to 100,000 R.P.M. This range is said to provide the most efficient cutting speed (approximately 5000 surface feet per minute) for grinding wheels or points ranging from 5/32 inch to 3/4 inch in diameter. The low-range unit can be adjusted to hold any selected speed within 35,000 to 50,000 R.P.M., while the high-range unit will hold any selected speed within 60,000 to 100,000 R.P.M.

The heads are designed to operate from an air line having a capacity of 25 cubic feet per minute at 80 to 100 pounds per square inch pressure. A line filter cleans the air before it enters the head, where it is distributed through internal passages to a turbine to drive the spindle, a speed governor control, and the air lubricated bearings. A pressure gage is used in conjunction with a speed chart on the nameplate to select the desired speed.

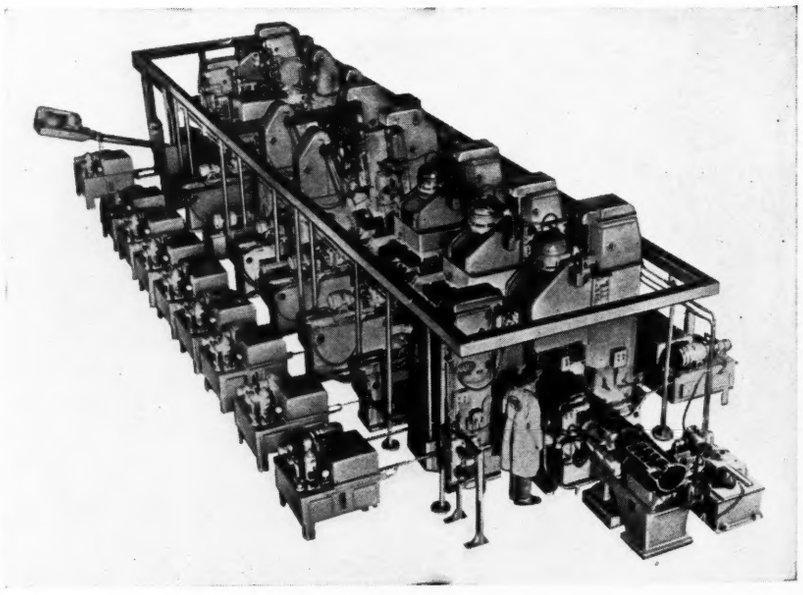
One of the outstanding features of these heads is their ability to operate under grinding load with a very small drop from the preset idling speed. The speed governor control, which makes this possible, works on the principle of the air gage to control the throttle valve which supplies the correct amount of power air to maintain the preset speed, regardless of the grinding load. Another important feature is the air bearings on which the spindle floats. The simple air lubricated journals and thrust bearings have no apparent speed limitations, and have been found to function as well at 100,000 R.P.M. as at low speeds.

The pressure gage, mounted on top of the head, indicates the nozzle pressure driving the turbine. The increase in gage reading is a direct measure of the amount of work the wheel is doing, and can be used to advantage to show instantly when the wheel comes in contact with the work. It can also be used to gage the hole size on ordinary repetitive jobs. By using the automatic in-feed on the grinder and withdrawing the wheel from the work when the needle on the pressure gage drops to an established reading after the automatic feed kicks off, it is possible to hold duplicate work within accuracy limits of 0.0001 inch.

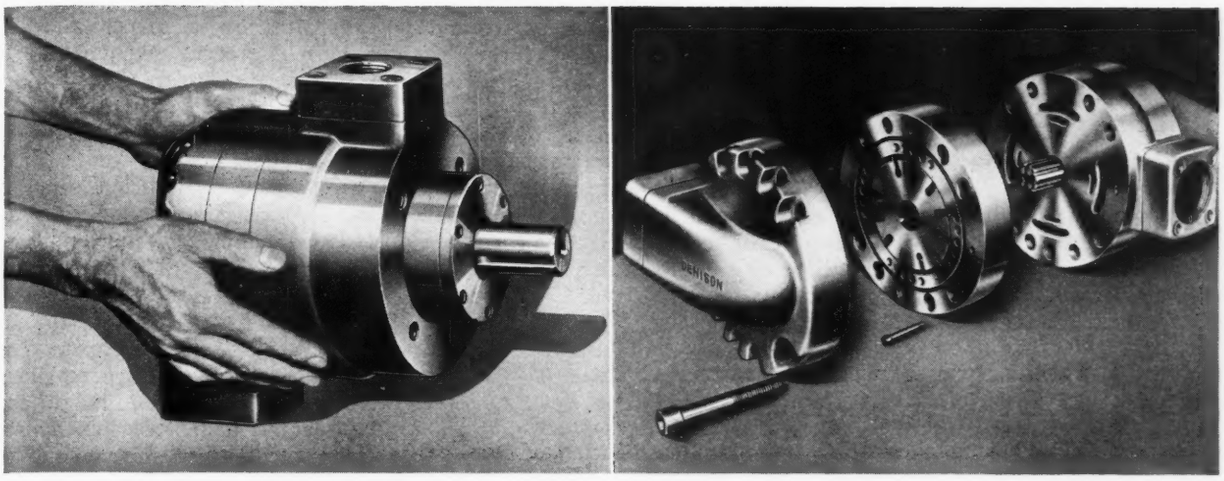
Provision is made for operating the pneumatic grinding head at any speed down to zero, in order to permit a safe truing speed to be used when bringing the wheel into balance.

Natco "Holeway" for Rapid Machining and Inspection of Cylinder Blocks

A new giant size Natco "Holeway" machine which performs 101 automatic operations approximately every 1.1 minutes, including inspection, has been built by the National Automatic Tool Co., Inc., Richmond, Ind. With only one man at the controls, this machine will turn out fifty cylinder blocks an hour.



Giant "Holeway" machine built by National Automatic Tool Co. for processing cylinder blocks



(Left) Dual-purpose pump-motor unit made by Denison Engineering Co. (Right) Exploded view of pump-motor shown at left

Operations performed by the machine include milling, trepanning, drilling, counterboring, reaming, chamfering, automatic turning of part 360 degrees while vibrating to remove all chips, and inspection of the finished work. The machine has a total of eighteen stations, two of which are used for loading and unloading, while six are idle.

Snyder Special Machine for Back Spot-Facing Cylinder Heads of Aircraft Engines

The Snyder Tool & Engineering Co., 3400 E. Lafayette, Detroit 7, Mich., has developed a special-purpose, high-production machine that back spot-faces twenty cylinder mounting holes in cylinder barrels and head assemblies for radial aircraft engines.

Since the operation is performed after the head has been assembled to the barrel, minimum working space is available for back spot-facing. Also, the radius that blends in from the barrel wall to the flange lengthens the required stroke considerably and demands rigid cutter mounting because of the interrupted cut.

The cutters are mounted in four radially moving hydraulically actuated segments, each containing five cutters, which form a circle when moved into their working positions. The part is located and clamped manually in the fixture, which is mounted on heavy guide bars.

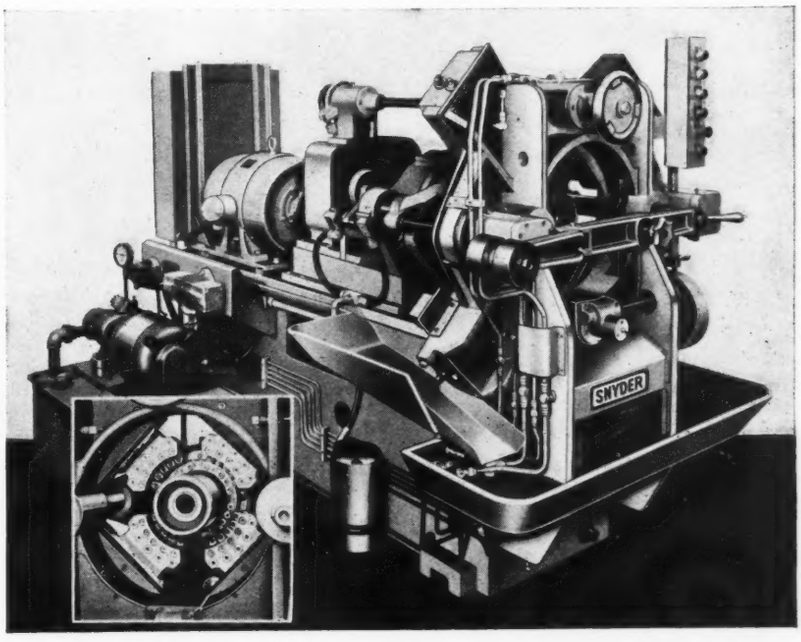
Pressing the starter button causes the cutter segments to move down into the cutting position between the barrel flange and the lower portion of the cylinder head. The twenty-spindle driver head is advanced manually until the cutters are engaged by the drivers which pass through the flange-bolt holes. The operator can also rotate the drivers manually into accurate alignment with the splined holes in the cutters.

When the work cycle starting button is pressed, the fixture, with the part, is fed into the cutters until the cut is completed. The fixture is then returned by rapid traverse to the starting position, the motor stops, the drivers are retracted manually, and the finished part is ready to be unloaded.

High-Pressure Vane Type Pump-Motor Unit

A vane type oil hydraulic pump that can also be used as a fluid motor has just been announced by the Denison Engineering Co., 1152 Dublin Road, Columbus 16, Ohio. The new pump-motor is of single-stage design, and is said to incorporate a new principle of radial balance and construction. No alterations of any kind are necessary within the unit itself in changing from motor to pump or from pump to motor operation.

The unit permits clockwise or counter-clockwise rotation, for both pump and motor operation. The three major parts of these



Snyder special machine for back spot-facing cylinder heads

pumps are easily disassembled by removal of a few cap-screws. Four sizes of these pump-motor units are available, and each size is offered with a choice of cam rings to widen the range of oil delivery or torque ratings. This provides eight models of different capacity levels. In pump applications, these capacities range from 2 1/2 to 60 gallons per minute. For fluid motor use, capacities range from 12 to 257 inch-pounds of torque per 100 pounds per square inch fluid pressure.

The exploded view of the new pump-motor shows the simplified, three-component compact construction. The pumping cartridge, positioned by only two screws, is easily turned over when reverse rotation is desired.

Metallograph with Polarized Light for Microscopic Study of Metals

A new desk type metallograph designed to permit microscopic study of metals under polarized light, as well as under phase and bright-field illumination, is announced by the American Optical Co., Instrument Division, Buffalo 15, N. Y. This new Model 2400P metallograph is said to retain all the features of the company's standard Model 2400A metallograph.

All operations can be performed while the operator is sitting comfortably at the desk, each control being within easy reach. Final focussing for photography is accomplished quickly, automatically, and accurately while examining the specimen through the parfocal visual system. This equipment is of special value to those laboratories dealing with anisotropic metals, identification of non-metallic inclusions where polarized light is required, examining of unetched specimens, or determining of differences in level of areas within a specimen.

Torrington Coil-Spring Testing Machine

To meet the demand for closer control in the manufacture of coiled springs, a new spring testing machine has been developed by the Torrington Mfg. Co., Box 808, Torrington, Conn. This machine is designed for use as a companion to the spring coilers made by the company. It provides a standard method of testing coiled springs.

The new tester is relatively inexpensive, simple to use, and has a high degree of sensitivity. It is designed to operate through a wide range of loads without loss of sensitivity, and has the advantage of measuring or testing springs under conditions similar to those met in actual use.

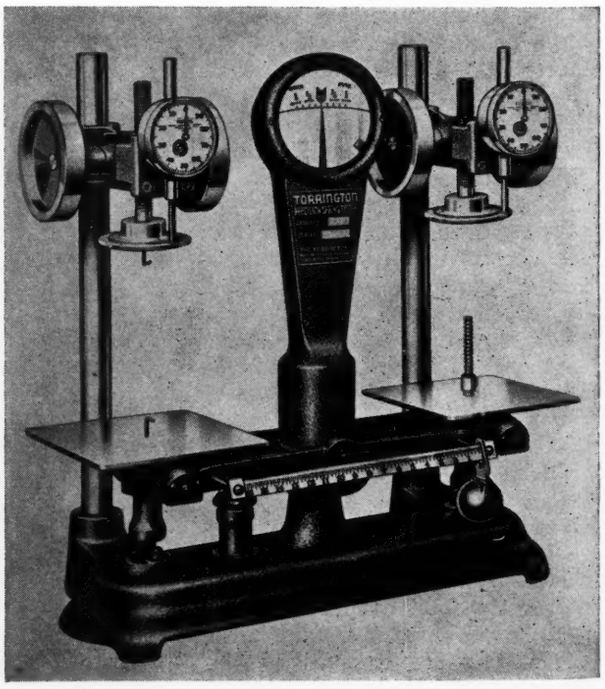
The machine can be employed for determining the spring gradient, checking free height in relation to load, and checking the effect of wire size on load. The determination of close-out load when approaching solid height can be readily made. Other applications include the measuring of initial tension in extension springs and the checking of effects of heat-treatment and plating.

Of the two models now in production, the smaller measures a load up to the nearest one-hundredth of an ounce and to a capacity of 3 pounds, while the larger model measures loads to the nearest fifth of an ounce and up to 16 pounds.

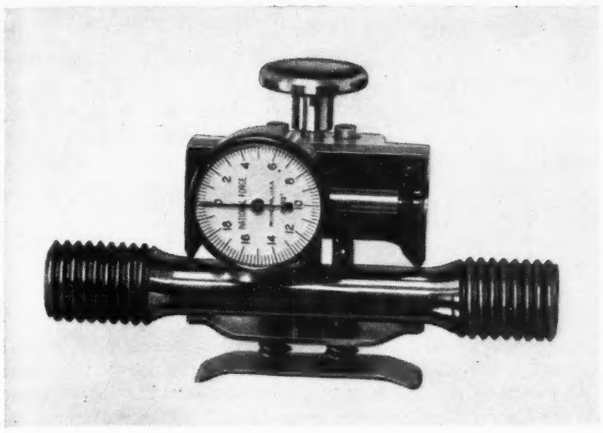
Extensometer for Indicating Elongation of Metallic and Plastic Specimens

Elongation of metallic and plastic specimens in tension testing can be determined directly, without a multiplying lever, on a newly designed, simplified extensometer

Metallograph for studying metals under polarized light, made by American Optical Co.



New type coil-spring testing machine placed on the market by the Torrington Mfg. Co.



Extensometer for indicating elongation in metal and plastic specimens

Hard chrome-plating unit made by Cro-Plate Co. for large and small shop use

brought out by the National Forge & Ordnance Co., Testing Machine Division, Irvine, Warren Co., Pa. This instrument weighs only 7 ounces, and can be attached to the specimen by spring clamps, which are opened or closed while the device is held in the palm of the hand.

The extensometer is readily adjusted to take wire, sheet, plate, or round specimens up to a maximum thickness or width of 1/2 inch. The standard gage length is 2 inches, but a special gage length of 1.4 inches is available. Elongation up to 0.045 inch in dial gradients of 0.0002 inch can be registered. The large-sized dial on the jeweled indicator permits accurate readings to 0.0001 inch.

Bench Model Hard Chrome-Plating Unit

The Cro-Plate Co., Inc., 747 Windsor St., Hartford, Conn., has announced a self-contained precision hard chrome-plating unit developed to meet a wide range of electroplating requirements. With the new "Cro-Plater 100," it is claimed that either large or small shops can economically handle their own plating work.

Cutting tools, gages, dies, molds, and machine parts subject to wear are said to average 300 per cent longer life when chrome-plated. The plating unit can also be used to salvage parts or tools machined or ground under size.

The bench model plater requires a space of only 2 by 3 feet, and yet all controls, transformers, rectifiers, switches, and heating elements, including the plating tank, are contained within the unit. A current source and duct outlet are the only connections required for immediate operation. The unit provides a rectified source of direct current power up to 100 amperes at 0 to 12 volts.

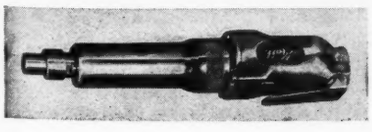
Mall Pneumatic Grinders

Two new pneumatic grinders have been added to the line of the Mall Tool Co., 7725 S. Chicago Ave., Chicago 19, Ill. The one shown in Fig. 1, known as "Shorty," is designed for production grinding and finishing operations. This compact grinder is claimed to be exceptionally powerful for its size and weight. It is built with precision parts, and is especially adapted for use by machinists, diemakers, aircraft manufacturers, and workers in the plastic industries. Outstanding features are comfortable hand fit; exhaust that directs air away from the operator toward the wheel to cool and clean the work; chuck guard; and a noise silencer arrangement designed to eliminate high-pitch tones.

This grinder can be used with such accessories as mandrel-mounted abrasive wheels and points, rotary files, carbide burrs, sanding and polishing discs, and shaping and finishing attachments for dies, molds, etc. It is equipped with Erickson precision collets, and has a maximum arbor run-out

Fig. 1. (Right) "Shorty" pneumatic grinder brought out by Mall Tool Co.

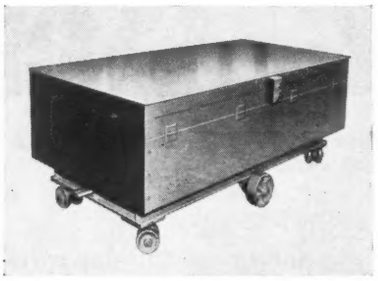
Fig. 2. (Below) Mall heavy-duty pneumatic die grinder



of only 0.0015 inch. The weight is 18 ounces, and the length 5 1/4 inches.

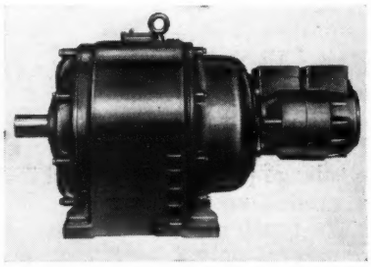
The other new Mall pneumatic die grinder—No. PGK2122L—shown in Fig. 2, is designed as a heavy-duty tool for extreme accuracy on large, tough grinding jobs. It is designed for rotary filing on aluminum and magnesium castings or for any fast, large-scale grinding job.

This small, compact grinder has an extended spindle that facilitates the application of greater pressure on the work. It is extremely light in weight—only 1 3/4 pounds—and has a powerful four-vane rotary motor that is adjustable to various speeds. The grinder has a speed regulator and quick-action lever throttle. It is accurately balanced to eliminate vibration, and is equipped with a new patented noise silencer. Eight sizes of Erickson collets are available.



Die Lift Table with Four-Point Support

Die lift table designed to meet a wide range of industrial applications. These tables are of extremely rugged construction, and are built in sizes from 30 by 36 inches to 44 by 84 inches, with capacities from 4 to 10 tons. Elevations are from 30 to 46 inches, mechanically operated. Air-operated or hydraulically operated units are also available. Features of these new tables include four-point support, magnetic reversing starter, and push-button control. Manufactured by the Union Tool Corporation, Warsaw, Ind.

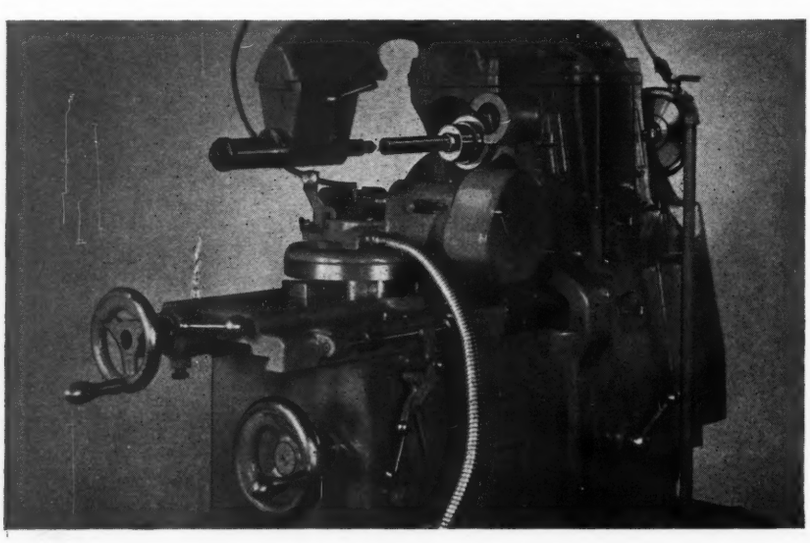


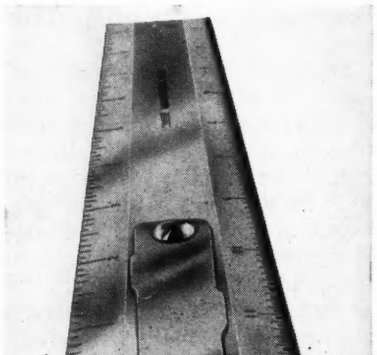
Rucker Fluid-Powered Speed Reducer

Fluid-powered speed reducer developed by the Rucker Mfg. Co., 4228 Hollis St., Oakland 8, Calif. This speed reducer is designed to make available all the gear ratios of conventional speed reducers, with complete control of motor speed from 0 to 2000 R.P.M. at constant torque and with full reversibility; and also at extreme torque down to 1 R.P.M. A specially designed hydraulic motor replaces the conventional electric motor as a power source. The fluid motor is explosion-proof. Regularly made in sizes up to 100-H.P. input, larger sizes being built to meet specific conditions. The model shown has a vane type motor, but piston type motors will be available later.

Work-Spindle for Hamilton Gear-Hobber

Gear-hobber with new draw-bar collet operated by a handwheel, announced as standard equipment by the Hamilton Tool Co., 834 South Ninth Street, Hamilton, Ohio. Much faster and easier to operate, the new collet adds greatly to the capacity of the machine for producing small precision spur, spiral, bevel, and face gears, worms and worm-gears, gear segments, and pinions by reducing the time required for loading and unloading. An additional feature of the new spindle design is the adjustable spindle nose, which assures trueness of the workpiece to within 0.0001 inch and simplifies the necessary adjustment for trueness when a change is made from work held in a collet to that requiring a work-holding fixture.





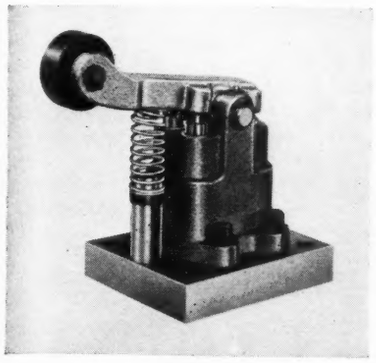
New Standard Line of "Duraline" Drafting Machine Scales

One of a line of standard improved metal drafting machine scales just introduced by the Universal Drafting Machine Corporation, 7960 Lorain Ave., Cleveland, Ohio. The new "Duraline" scales consist of the twelve standard types of graduations most used by civil, mechanical, and electrical engineers, draftsmen, and architects. Each style is available in 6-, 12-, 18-, and 24-inch lengths. These scales are made of an aluminum alloy. They are engine divided at 70 degrees F. to produce graduations of high accuracy. After the graduations are blacked in, a new anodized finish is applied that makes lines and figures stand out in contrast against the dull light gray of the metal. While these scales were designed for

use with Universal "Boardmaster" drafting machines, the chucks with which they are fitted permit their being used on any standard drafting machine.

Ross Small-Sized Cam-Operated Valve

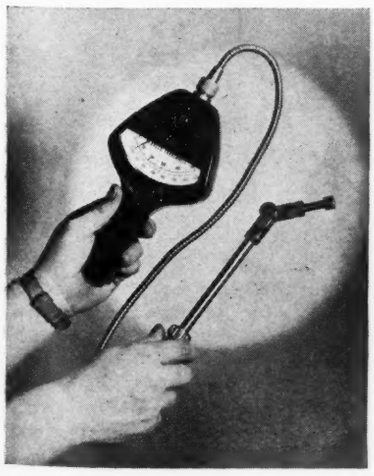
Small-sized cam-operated valve announced by Ross Operating Valve Co., 120 E. Golden Gate, Detroit 3, Mich. Excluding the cam roller, the new unit is less than 4 inches high, and has a

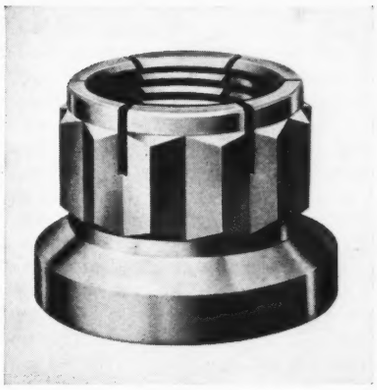


base of only 3 by 3 1/2 inches. It is a 1/4-inch four-way valve with a long lever. The travel of the lever is less than 1 inch.

G-E Hand Pyrometer with Two Scale Ranges

New hand pyrometer with two scale ranges for rapidly and conveniently measuring the temperatures of metal surfaces, as well as liquids, gases, and molten metals. Three interchangeable tips available for this FH-1 pyrometer include a surface tip, an immersion tip for liquids and molten metals, and a two-pronged contact tip. Typical applications include temperature checks of plastic molds, metals used in die-casting, and preheated metals for welding. Announced by the General Electric Co., Schenectady 5, N. Y.





High-Strength Nut

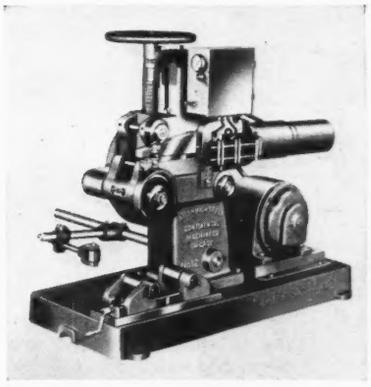
External wrench type nut made by Standard Pressed Steel Co., Box 887, Jenkintown, Pa. Originally designed for aircraft use, but can be applied wherever space is at a premium and high tensile strength is necessary. The tensile strength of these "Flexloc" nuts is in excess of 160,000 pounds per square inch; the 1 1/4-inch size, for example, has a minimum tensile strength of 193,700 pounds, and yet weighs only 0.52 pound. It has twelve-point serrations to fit standard box or socket wrenches. All-metal, one-piece construction permits its use at temperatures as high as 550 degrees F. without loss of locking efficiency. Approved for aircraft use in sizes from 1/4 inch to 1 1/2 inches in the NF thread series.

Jig and Fixture Components

New latch bolt, spherical washers, and fixture key recently added to the line of jig and fixture components manufactured by the Northwestern Tool & Engineering Co., 115 Hollier Ave., Dayton 3, Ohio. The latch bolts are made in 3/8-16, 1/2-13, and 5/8-11 sizes. Spherical washers of the type shown are available in 3/8-, 1/2-, 5/8-, and 3/4-inch sizes. The fixture keys are made in 1/2-, 9/16-, 5/8-, 11/16-, 3/4-, and 13/16-inch sizes.

Automatic Pipe and Tube Cut-Off Machine

Machine for automatically cutting off pipe and tubing up to 12 inches in diameter. Equipped to cut off as many as sixty pieces of 12-inch pipe or tubing per hour. Smaller sizes can be cut at a proportionately faster rate. When the machine operator feeds the pipe to an adjustable stop and steps on a foot-switch, the pipe starts spinning slowly as it is engaged by the blade. Heavy

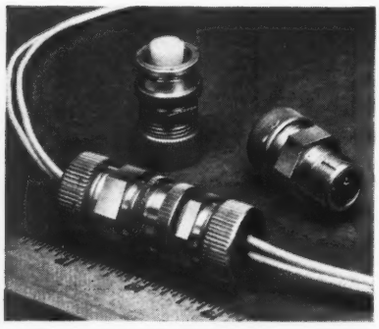


cutting pressure is then exerted to complete the cutting operation. Announced by the Continental Machine Co., 1952 N. Maud Ave., Chicago 14, Ill.

Diamond Cutters for Marking Hardened and Ground Tool Steel

Cutters made with diamonds faceted to a sharp point and faceted edges for use in engraving, routing, electric marking, and acid etching machines. When mounted in the spindle of an engraving machine and operated at high speed, these diamond cutters will produce very clear marks to a depth of up to 0.005 inch, depending on the material and degree of hardness. They are especially adapted for use in a pantograph type of machine for reproducing any

size and style of lettering and numbering desired. Furnished in straight- and tapered-shank styles by the H. P. Preis Engraving Machine Co., 165 Industrial Branch, Hillside, N. J.



Titeflex Light-Weight Electrical Connectors

Light-weight electrical connectors now being manufactured by Titeflex, Inc., 500 Frelinghuysen Ave., Newark 5, N. J. These connectors are designed to meet special requirements of temperature, corrosion, and vibration. They are available for general use on electrical equipment, and will be furnished in seventeen shell sizes conforming to AN sizes 9 to 36 inclusive. Can be furnished for cord connections, shielded assemblies, and bulkhead or box mountings as required.

"Roll-Over" Type Furnace for Precision Casting

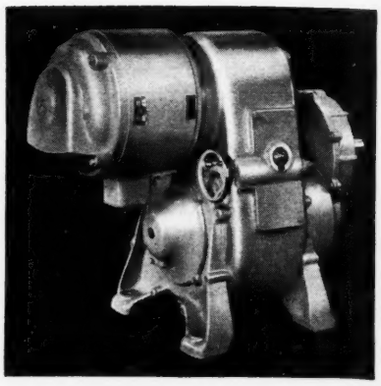
Mechanically operated induction furnace developed for use in the production of precision castings. The new furnace is designed to transfer molten metal from furnace to mold in any preset cycle, usually requiring only a few seconds. Typical parts being cast with the new unit include jet-engine vanes and blades, compressor parts, and small ordnance components. The furnace is powered by a standard Ajax-Northrup 20-kilowatt mercury-hydrogen type converter, and operates at a frequency of about 30,000 cycles. The converter can also be used to power other melting furnaces, and can be applied to various types of heating equipment for heat-treating, brazing, etc. Both converters and furnaces are manufactured by the Ajax Electrothermic Corporation. Trenton 5, N. J.

Skinner Explosion-Proof Solenoid Valve

New X5 type solenoid-operated valve brought out by the Skinner Electric Valve Division, Skinner Chuck Co., Norwalk, Conn., which is of the same general design as this company's V5 type, but with modifications to meet or exceed all of the Underwriters Laboratories' requirements for Class I Group D explosion-proof construction. The valve operates on 10 watts. It has soft leak-proof spring-loaded seals; stainless-steel internal parts; and a wide variety of port locations in 1/8- and 1/4-inch sizes. Most types are available with metering, and can be supplied for alternating or direct current in a wide range of voltages and frequencies.

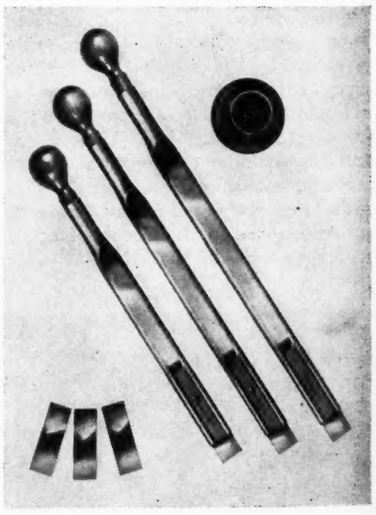
Sterling Reduction Gear Units

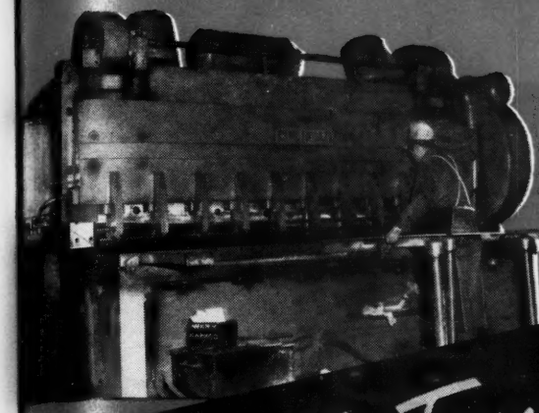
Variable-speed unit with single reduction gears available in ratings of 20 and 25 H.P. This unit has just been announced by Sterling Electric Motors, Inc., 5401 Anaheim-Telegraph Road, Los Angeles 22, Calif. It will be manufactured in speeds of 728 R.P.M. and lower, with infinite speed adjustment within the ranges of 2 to 1, 3 to 1, or 4 to 1. The 25-H.P. single-reduction model illustrated has a speed variation of 4 to 1 and output speeds of 324 R.P.M. down to 81 R.P.M. Features include positive adjustment of pulleys, accurate maintenance of speeds under varying loads, correct belt tension in proportion to load, positive oil seals, single-train helical gears, herringbone rotor, and direct-through ventilation. All units are available with drip-proof or splash-proof construction.



Anderson Hand Scrapers

New hand scrapers for flat surfaces, developed by Anderson Bros. Mfg. Co., 1907 Kishwaukee St., Rockford, Ill. These scrapers are constructed of seamless tubing, which combines light weight with flexibility. The Model 5 scraper uses replaceable blades 1 3/32 inches wide by 1/16 inch thick. The blade is the same width and thickness throughout its entire length, and after it is once sharpened, stoning is all that is necessary to maintain the cutting edge. A rubber pad (seen at the upper right), which fits the round socket type handle, is available for use when the scraper is placed against the body to obtain additional leverage. The scrapers are made in three lengths of 22, 20, and 18 inches. The standard hand scraper accommodates both high-speed steel and tungsten-carbide-tipped blades.





SHEARING and FORMING a GIANT

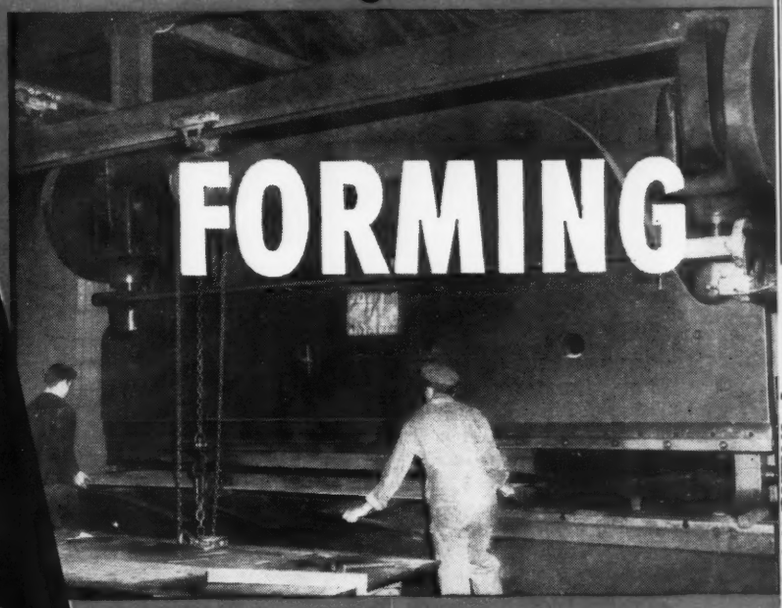
The Story of a Team

Steel sheets for these Giant Marion Shovels are formed with great accuracy on a Cincinnati 210 Series Brake. The blanks sheared square and true on a Cincinnati 100 Series Shear—contribute to this accurate forming that speeds and simplifies assembly.

This Cincinnati Brake, with 16 feet of die surface, is forming 3/8" plate into lower frame pieces. The one inch capacity shear is cutting 3/4" plates for the shovel platform or upper deck.

Save time, save money with this dependable Cincinnati Team.

Write for Shear Catalog S-6 and Brake Catalog B-3.



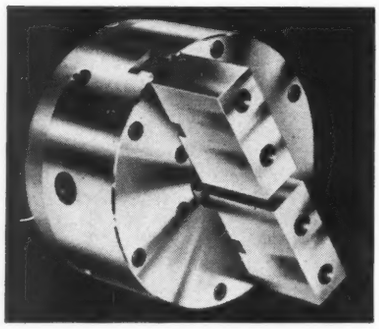
The Marion 5561, World's Largest Mobile Land Product, with a 45 cubic yard shovel. Photos—Courtesy of Marion Power Shovel Co., Marion, Ohio.

THE CINCINNATI SHAPER CO.

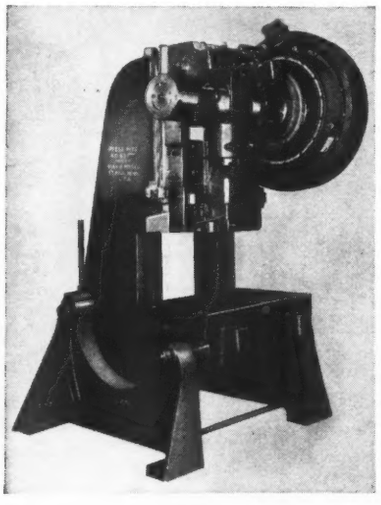
CINCINNATI 25, OHIO, U.S.A. SHAPERS • SHEARS • BRAKES

Buck "Ajust-Tru" Two-Jaw Aviation Chuck

"Ajust-Tru" two-jaw aviation chuck for use in chucking irregular-shaped parts. This chuck has been designed to assure accuracy within 0.0005 inch on large



as well as small lot jobs. It will rechuck work at the same speed as a scroll chuck without need for further adjustment. The chuck is made with master jaws, and two soft blank top jaws are supplied which can be machined to hold odd-shaped parts for lathe or drill press. Soft jaws can be hardened after machining to shape if desired for long-run work. Made in 6- and 7 1/2-inch diameters by the Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.



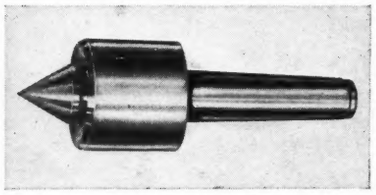
"Press-Rite" Open-Back Inclinable Press

New "Press-Rite" 60-ton open-back inclinable press introduced by the Sales Service Machine Tool Co., 2351 University Ave., St. Paul 4, Minn., which was described in March MACHINERY, page 217.

Caddy Electrode-Holder

Fully insulated Caddy Type B 500-ampere electrode-holder brought out by Erico Products, Inc., 2070 E. 61st Place, Cleveland 3, Ohio. This holder is light,

weighing only 25 ounces. It is designed for more efficient and cooler operation through "Cadwelding" the cable directly to the replaceable jaw, which is made of a high-conductivity copper alloy. This provides a solid copper circuit from the welding machine to the electrode, with no mechanical connections. Other features are a cable gripper at the rear of the steel body that prevents any flexing at the weld and eliminates need of insulating the connection; and adjustable spring tension.

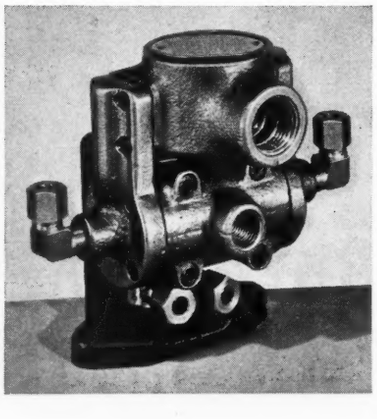


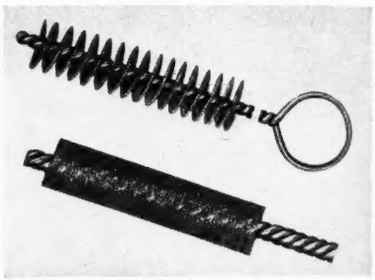
Precision Live Center

"Quadro" precision live center for use on lathes, milling machines, turret lathes, and other machine tools. This live center is designed to maintain an exceptionally high degree of accuracy. Two double-row ball bearings absorb radial and end thrust. Introduced by Dakon Tool & Machine Co., Inc., 496 Broadway, Brooklyn 11, N. Y.

Bellows Explosion-Proof "Electroaire" Valve

Explosion-proof, low-voltage electrically controlled air-powered air valve announced by the Bellows Co., 230 W. Market St., Akron 9, Ohio. Built into this one integral unit are a four-way directional slide valve, solenoid control units, and piston-rod speed regulators. The valve meets Group D, Class 1 Standards for wiring in hazardous locations as established in the National Electric Code of the National Board of Fire Underwriters. Made in three models for 1/4-, 3/8-, and 1/2-inch pipe tap outlets to cylinder and air inlets.





Mill-Rose Wire Brushes

The Mill-Rose Co., 1985 E. 59th St., Cleveland, Ohio, has made available fifty-eight standard sizes of single- and double-spiral twisted wire brushes for hand and power operation, such as seen in the illustration. The sizes range from 1/8 to 1 inch in diameter in single-spiral types for hand operation, and from 1/4 to 1 inch in diameter in double-spiral types for power operation, varying by 1/16-inch increments.

Zenith Cleaning Machine for Mechanical Instruments and Small Parts

New machine, called the "Instro-Met," designed for cleaning every kind of instrument with small or large delicate parts. Three clear-view windows on motor support permit instant checking of work while machine is in operation. Spun aluminum tanks are 10 inches high and 10 inches in diameter, with a capacity of 4 gallons Heavy cast aluminum basket has inside diameter of 7 3/16 inches and is 3 3/4 inches deep. Product of Zenith Mfg. & Chemical Corporation, 52 Beekman St.. New York 38, N. Y.

Between Grinds

By E. S. Salichs

Rods Pinch-Hit, Are Pinched

Westward (house organ of the Kaiser Steel Corporation) tells us that in the 1920's, W. F. and S. M. Stoody set up a small general welding business in Whittier, Calif., and experimented with alloy-coated rods. Then the brothers bought some "dime store" curtain rods, filled them with alloy, cut them, and pinched the ends to keep in the finely ground particles. So the young company developed an interest in tubing as well.

Colorful Wheel

A color scheme designed for safety was worked out by the King Fifth Wheel Co. in its workshop, with this pleasing result: Walls two-tone green—upper half a soft pastel shade, lower half a hardy forest green —ceilings white, ground equipment sprayed a dark green with control handles and switches a bright red, overhead cranes and hoists yellow, and safety switch boxes a brilliant orange.

S'No Joke

Last month in our item about a snow thrower we were in error, referring as we did to *square* feet of snow. Seems snow comes only in *cubic* feet. We walked into this frosty situation by quoting a news release; the agency that sent it in evidently never got around to measuring the stuff either.

Plastic Interest

An article in the January number of MACHINERY (Technique Used in Producing Plastic Tooling for Aircraft) has brought the author, Roy Venable of Northrop Aircraft, Inc., Hawthorne, Calif., a number of requests for further information from aircraft and automotive companies — including two telephone calls from Chicago. Roy modestly remarked: "It is good to know that all the work we've done hasn't gone unnoticed."

He Even Asks for It!

A book MACHINERY received for review contained a card from its publisher: "The author is interested in knowing what you think is the worst thing about his book. (He wishes to improve it.)"

Down Inco's Hatch

In testing average corrosion rates of Ni-Resist tanks as compared with cast-iron tanks over a period of three months, International Nickel Co., Inc., selected among other specimens "thin whiskey slop." Results of this test should be of interest to the boys with the cast-iron stomachs.

MEMBER OF MACHINERY'S FIFTY-YEAR CLUB—Clyde W. Blakeslee tells us he has been a subscriber to our magazine since 1894, and that a great deal of his mechanical knowledge was obtained over the years through reading "the thousands of interesting articles in MACHINERY." Mr. Blakeslee was born in the small village of Neponset, Ill., in 1874. He started work at the age of fourteen (at a salary of $4 weekly), turning out blanks on a Barnes foot power lathe with a micrometer divided into thousandths of an inch—not ten-thousandths—in a hayloft Two years later, he joined the Samuel Harris

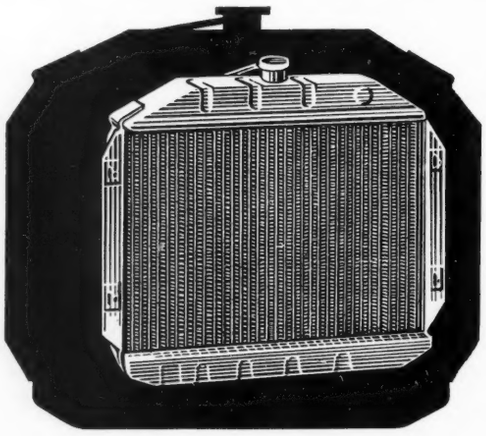
Co., and at the age of eighteen became a salesman (was advanced $35 for his first ten-day trip) working out of Chicago, for that company, then C. H. Besly & Co., and in 1900, for the Norton Emery Wheel Co. From 1920 until his retirement in 1946, Mr. Blakeslee was with the N. A. Strand Co., also of Chicago. While there, he assisted in the development of over a hundred various types of machines and attachments to fit them. Mr. Blakeslee now lives in Elkhorn, Wis., and retains his keen interest in the machinery industry, its past history and present achievements.

BUSINESS IN MOTION

To our Colleagues in American Business . . .

Substitution of materials is of considerable concern to many manufacturers these days. Never before have we seen so much interest in the subject. However, it is by no means new to Revere, which has always held to the principle of recommending the metal that will best serve the customer. Thus, we have often suggested switching from one metal or alloy to another, with the object of lowering costs, increasing production, improving service, or all three.

When based on a detailed study of all the factors involved, substitution at times can be extremely valuable. In fact, the ever-increasing quality and service to be found in American products is due in part to the continued search for better materials, and their adoption when found. Better materials, better design, finer workmanship—these are part of American progress.



But there are instances, of course, when no practical substitute can be found, when only one material offers just the right combination of good qualities required for a given application. Take the automobile radiator. This has always been made of copper, because copper is the one and thus far only metal that perfectly meets all the requirements of manufacture and service. To make a radiator, very thin copper sheet and strip must be crimped, bent and otherwise formed. Copper's easy workability makes it ideal from the manufacturing standpoint. After assembly, the radiator is cleaned, and made water-tight by dipping in a bath of hot solder. Copper is exceptionally easy to solder. When in service on a car, truck or bus, the radiator must not rust, and must resist corrosion by water and anti-freeze. Copper is notable for its resistance to corrosion in such use. The radiator must also cool the water by radiating its heat into the air stream; copper has the highest heat conductivity of all commercial metals. A copper radiator thus is the most efficient and durable. It should outlast the car unless accidentally damaged, and when the injury is not so great as to make replacement necessary, the nearest shop can make repairs easily.

Recently it has been suggested that automotive radiators should be made of aluminum. However, both copper and aluminum are temporarily in short supply, and therefore to substitute one for the other does not appear to be practical. Beyond that, we do not believe —based upon experience to date—that aluminum's qualities, fine though they are, necessarily make it suitable for automotive radiators. In addition, the difficulties of retooling in the factory and repairs in the field must be considered. Revere fabricates both copper and aluminum, and we have reason to believe that our impartial advice to stay with copper for automotive radiators is concurred in by radiator manufacturers.

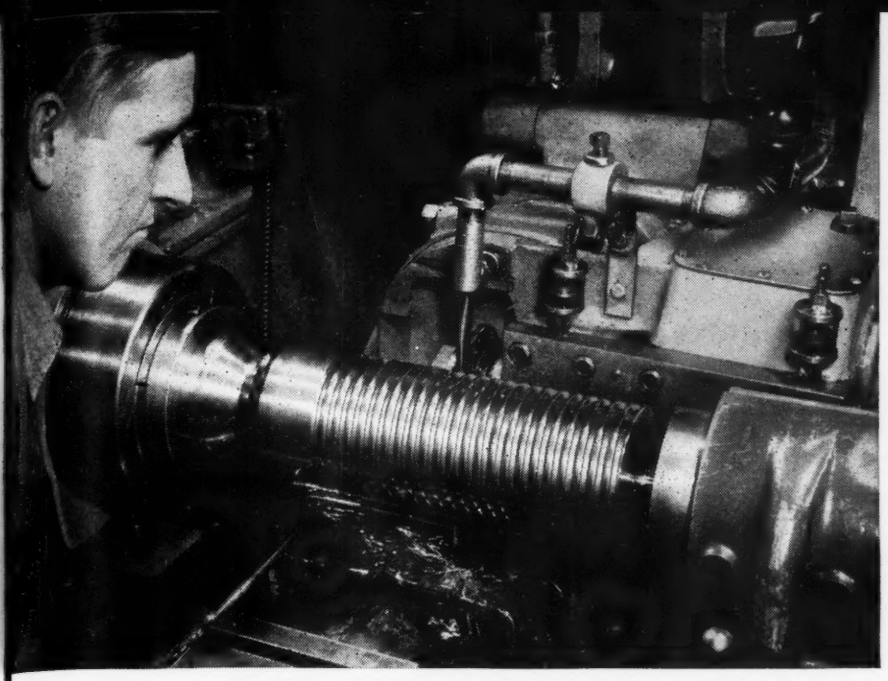
When you are tempted to substitute one material for another in your product, no matter what it may be, make certain you obtain all the facts as to costs, production, service. Your suppliers will be glad to collaborate with you in studying the effects of a proposed change. We suggest you take full advantage of their knowledge and experience.

REVERE COPPER AND BRASS INCORPORATED

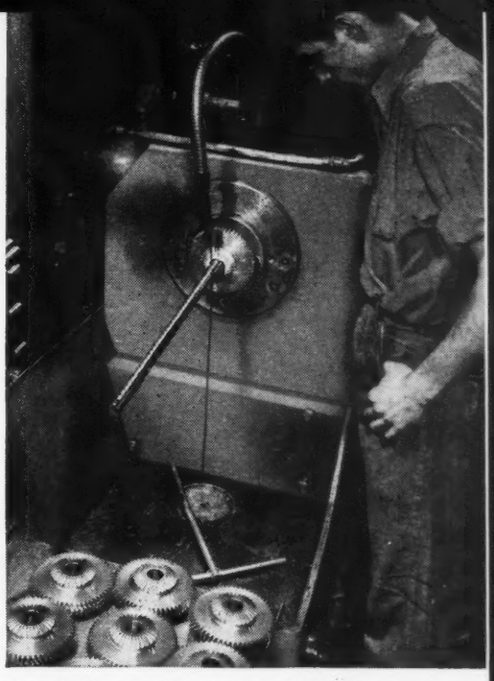
Founded by Paul Revere in 1801

***Executive Offices:* 230 Park Avenue, New York 17, N.Y.**

SEE "MEET THE PRESS" ON NBC TELEVISION EVERY SUNDAY



THREAD MILLING A SCREW. Metal: SAE 2345 steel heat-treated to 28 Rockwell • Machine: Lees Bradner thread miller • Part: 5¼" adjusting screw for press brake • Operations: rough and finish thread milling Tool: high-speed steel • Feed: 0.260 depth on roughing Cutting Oil: Sunicut 105



BROACHING A GEAR KEY-WAY. Metal: SAE 2345 steel forging 220 Brinnell • Machine: 3L8 La Pointe hydraulic broach • Part: gears for shaper, produced two at a time • Tool: 3′ high-speed steel broach • Cutting Oil: Sunicut 105

SUNICUT 105 REPLACES THREE OILS AND SOLVES FIVE MAJOR PROBLEMS

Buying three cutting oils and then blending them to make additional grades had proved highly unsatisfactory to a machine tool builder. The smoke was noxious, employees complained of skin irritations, the color of the oils made it difficult to see the work, tool life was short and finishes not up to standard. To help solve these problems, the company called in a Sun representative and on his advice tested Sunicut 105 on the three tough jobs pictured here.

So good were the results that the company adopted Sunicut 105 for every machine in the plant and has used it exclusively for the past two years. The operators like its transparency. There are no complaints about smoke or skin irritations. Finishes have improved and tool life increased as much as 50 percent.

For complete information on Sun's cutting oils, write to Department M-9 and we will send you a copy of our informative, illustrated booklet "Cutting and Grinding Facts."

CUTTING A LARGE GEAR. Metal: bronze 180 Brinnell • Machine: Gould & Eberhardt gear hobbing machine • Part: main drive worm gear wheel for large shear • 42⅝" O. D.; 5" thick; 87 teeth • Tool: high-speed steel hob • Feed: 0.006 • Speed: 42 rpm • Cutting Oil: Sunicut 105

SUN INDUSTRIAL PRODUCTS

SUN OIL COMPANY, PHILADELPHIA 3, PA. • SUN OIL COMPANY, LTD., TORONTO AND MONTREAL

SUNOCO®

News OF THE INDUSTRY

California

GEORGE CORSI, plant engineer of the National Motor Bearing Co., Inc., Redwood City, Calif., has been made chief process engineer. JOSEPH G. BRACCO has been appointed plant engineer in Mr. Corsi's stead.

GEORGE K. OTIS was recently elected vice-president of Lear, Inc., Grand Rapids, Mich. Mr. Otis will continue as general manager of the LearCal Division, which is located in Los Angeles, Calif.

ED SWIATEK has been appointed sales manager of the Diamond Machine Tool Co., Los Angeles, Calif., manufacturer of punch presses, milling machines, power shears, turret presses, and lathes.

DUCOMMUN METALS & SUPPLY CO., Los Angeles, Calif., was recently appointed distributor for the SIMONDS SAW & STEEL CO., Fitchburg, Mass., manufacturer of cutting tools.

PATRICK J. GLEASON has been made general sales manager of the Tap & Drill E-Z Corporation, El Segundo, Calif., manufacturer of lubricants.

GUS M. BAGNARD was recently made chief engineer of the Chiksan Co., Brea, Calif.

Colorado

STEMAC CO. recently purchased the W. L. FREEMAN MECHANICAL ENGRAVING CO. and is consolidating the business at 1277 S. Cherokee St., Denver, Colo. The enlarged facilities of the company will include die casting, manufacturing of machine tools, steel stamps and dies, etc.

STERLING ELECTRIC MOTORS, INC., Los Angeles, Calif., has opened a district office in Denver, Colo., and has appointed JAMES R. HUGHES district manager.

C. A. NORGREN CO. recently moved into its new plant at 3400 S. Elati St., Englewood, Colo.

Illinois and Indiana

W. J. FITZPATRICK has organized a sales and engineering company to be known as FITZPATRICK ENGINEERING CO., INC. The new company, located in Chicago, Ill., will handle sales and service for the Arthur Colton Co., Division of Snyder Tool & Engineering Co., Detroit, Mich., and products of the Ertel Engineering Co.

HARRY A. PORTER, JR. has been appointed head of the Chicago office of Michiana Products Corporation, Michigan City, Ind., manufacturer of alloy castings and high temperature fans, succeeding J. H. Staiger. The office is located at 80 E. Jackson Blvd., Chicago, Ill.

JOHN C. HELIES has been appointed general manager of the newly established appliance control department of the General Electric Co., with headquarters at Morrison, Ill. He was formerly with the company's Small Appliance Division at Bridgeport, Conn.

KROPP FORGE CO., Chicago, Ill., announces that the name of its subsidiary, A. C. WOODS & CO., Rockford, Ill., has been changed to KROPP STEEL CO. The subsidiary company is engaged in the steel fabricating and weldment business.

P. J. MUSOLF was recently elected vice-president and factory manager of the Sunbeam Corporation, Chicago, Ill., manufacturer of shearing machines and industrial furnaces.

H. C. WEBSTER has been appointed manager of the Chicago branch of the Moore Products Co., Philadelphia, Pa.

Z. R. WILLIAMS has been appointed vice-president and works manager for Portable Electric Tools, Inc., of Chicago, Ill.

RAYMOND S. WOOD has been appointed general manager of the Dodge plant of the Link-Belt Co., succeeding C. V. LOUGHERY who has retired after fifty years of service with the company. The Dodge plant manufactures ball and roller bearings at Indianapolis, Ind.

Maryland, Louisiana, and Texas

ARTHUR J. BUCKLEY has been appointed assistant sales manager for the Pangborn Corporation, Hagerstown, Md., manufacturer of blast cleaning and dust control equipment. Mr. Buckley has been associated with the Harnischfeger Corporation, Milwaukee, Wis., for the last eleven years.

J. D. TRICE has been appointed manager of the recently opened New Orleans sales office of Sterling Electric Motors, Inc., Los Angeles, Calif. The New Orleans office is located at 12 San Jose Ave., New Orleans 21, La.

EARL D. HOYT has joined the Dallas, Tex., technical staff of the Lamson Corporation, Syracuse, N. Y., in the capacity of field engineer.

Michigan

WALTER F. CAHILL CO., agent for tools, fixtures, production machinery, and precision gaging equipment, has moved from the New Center Bldg., to 17141 James Couzens Highway, Detroit 35, Mich. In the Detroit area the company represents Lincoln Park Industries, Inc., Gairing Tool Co., Seneca Falls Machine Co., and several other manufacturers.

R. J. FORESMAN was recently appointed general sales manager of the Mid-West Abrasive Co., Owosso, Mich. He has also been elected to the Board of Directors to fill the vacancy occasioned by the death of the late Phil Huber, chairman of the board of Ex-Cell-O Corporation.

THE CROSS CO., Detroit, Mich., has enlarged its main plant by the addition of a building containing 33,000 square feet of floor space. The building will be occupied by an expanded engineering staff.

JOHN C. FREMLIN has been appointed representative in the Michigan territory for the Billings & Spencer Co., Hartford, Conn., manufacturer of wrenches and shop tools.

UDYLITE CORPORATION is beginning construction of a research laboratory on a twenty-three-acre site at Hoover Ave. near Eight Mile Road in Detroit, Mich.

HENRY C. WULFF has become plant superintendent of the Lincoln Park Division of the Lincoln Park Industries, Lincoln Park, Mich. Prior to his present appointment, he held the position of assistant works manager.

"COORDINATED GEAR PRODUCTION"

the simple road to better gears at lower cost

The development by Michigan Tool Company of a COMPLETE line of gear production equipment—from blank to finished gear—permits you to ENGINEER and coordinate your gear production process the same way—from blank to finished gear.

Michigan Tool offers you an EXCLUSIVE service. We not only can supply the best of equipment for every step in the production of helical and spur gears and splines but we can take the complete and UNDIVIDED RESPONSIBILITY—assuring that all the steps will function as a coordinated and integrated whole.

Stop in and see us in Booth 1200 at the 1952 ASTE Industrial Exposition in Chicago.

MICHIGAN TOOL Company

7171 E. McNICHOLS RD. · DETROIT 12, MICHIGAN, U. S. A.

New England

CHARLES R. SKINNER, formerly assistant to the purchasing manager, has been promoted to purchasing agent of raw materials for Pratt & Whitney Aircraft, Division of United Aircraft Corporation, East Hartford, Conn.

EARL ELWYN SMITH ASSOCIATES, West Hartford, Conn., have been appointed sales engineers and dealers in the eastern states for the OVERLOAD CONTROL Co., Glen Oaks, Long Island, N. Y.

VINCENT L. BRADFORD, vice-president in charge of sales for the Milford Rivet & Machine Co., Milford, Conn., has been appointed to the post of director of advertising.

MICHAEL E. ERRICO has been appointed sales engineer for the Laminated Shim Co., Glenbrook, Conn., in New England.

CHARLES G. GRIMES has been appointed purchasing agent for the Roehr Products Co., Waterbury, Conn.

PERKINS MACHINE & GEAR Co., West Springfield, Mass., has purchased the manufacturing rights to the Bendit metal forming machine from Kilham Engineering, Inc., Plainville, Mass., and the CONNORS & DAVIS SALES CORPORATION, West Springfield, Mass., has become agent for the national distribution of the Bendit machine.

FREDERICK J. UNDERWOOD was recently appointed publicity manager for the Heald Machine Co., Worcester, Mass. PHILIP H. WARREN, JR., was appointed assistant publicity manager. Both men will handle the advertising and public relations programs for the company.

ALEXANDER SELLERS, JR. has been named sales development manager for the Machine Tool Division of the Van Norman Co., Springfield, Mass.

J. P. LITTLE was recently appointed sales manager of the Exeter Brass Division of the Bridgeport Brass Co. at Exeter, N. H.

EDWARD W. MILLER, president of the Fellows Gear Shaper Co., Springfield, Vt., has also been elected general manager. ROGER M. KNOX has been named assistant to the president. EDWIN R. FELLOWS II, has been elected a director and appointed assistant general manager. He will continue to serve also as manager of the export department.

New York

CARL A. SALMONSEN has been appointed general manager of the newly formed industry control department of the General Electric Co., Schenectady, N. Y. Mr. Salmonsen, who has been with the company for more than forty-two years, was manager of manufacturing of the company's former Large Apparatus Division before his present appointment.

PRECISION CASTINGS Co., INC., Fayetteville, N. Y., recently announced the following executive promotions: WILLIAM J. DURING, previously vice-president and general manager, has become executive vice-president; J. J. PUNKE, ALBERT LINTEL, and Ross W. CASTLE have been advanced to the positions of vice-presidents.

ROBERT C. KLEINDINST has been made representative for New York State and northern Pennsylvania by the Dollin Corporation, Irvington, N. J., producer of zinc and aluminum die castings. Mr. Kleindinst's headquarters are at 1200 Niagara St., Buffalo 13, N. Y.

W. FRANK KELLY was recently appointed assistant vice-president of the American Manganese Steel Division, American Brake Shoe Co., New York City. Mr. Kelly had been general superintendent of foundries since 1946 and the position he vacated will be filled by JOHN E. HOLTMAN.

RICHARD C. LAWSON was recently appointed assistant manager of the railroad and spring sales department of Crucible Steel Company of America, New York City.

OAKITE PRODUCTS, INC., manufacturers of specialized cleaning and allied materials, announce the removal of their offices from 22 Thames St. to 19 Rector St., New York 6, N. Y.

Ohio

PAUL BYRD has been appointed district manager of the Massillon territory for the Reliance Division of the Eaton Mfg. Co., Massillon, Ohio, producer of industrial fastening devices. Mr. Byrd's territory includes portions of Ohio, Kentucky, Tennessee, and all of Virginia and West Virginia.

RELIANCE ELECTRIC & ENGINEERING Co., Cleveland, Ohio, has announced the removal of two district sales offices to larger quarters: the Detroit, Mich., office will be located at 12326 Hamilton Ave.; while the Cleveland, Ohio, office will be located at 13967 Cedar Road.

J. LEE HACKETT MACHINERY Co., Detroit, Mich., has announced the opening of a Cleveland, Ohio, office at 1144 Hanna Bldg., with J. ALDEN RIGDON in charge. The branch represents the Mattison Machine Works, Greenlee Bros. Co., and several other machine tool builders.

Noble B. Clark, newly appointed sales manager of the Machine Tool Division of Warner & Swasey Co.

NOBLE B. CLARK has been appointed to the newly created post of sales manager of the Machine Tool Division of the Warner & Swasey Co., Cleveland, Ohio. Mr. Clark, who will also continue his duties as manager of foreign sales for the company, is at present in Japan on a special mission for the National Production Authority.

JOHN E. CINKOSKY has been appointed eastern zone manager of the Mercury Clutch Division of Automatic Steel Products, Inc., Canton, Ohio. He was formerly vice-president in charge of sales for the Centric Clutch Co., Woodbridge, N. J.

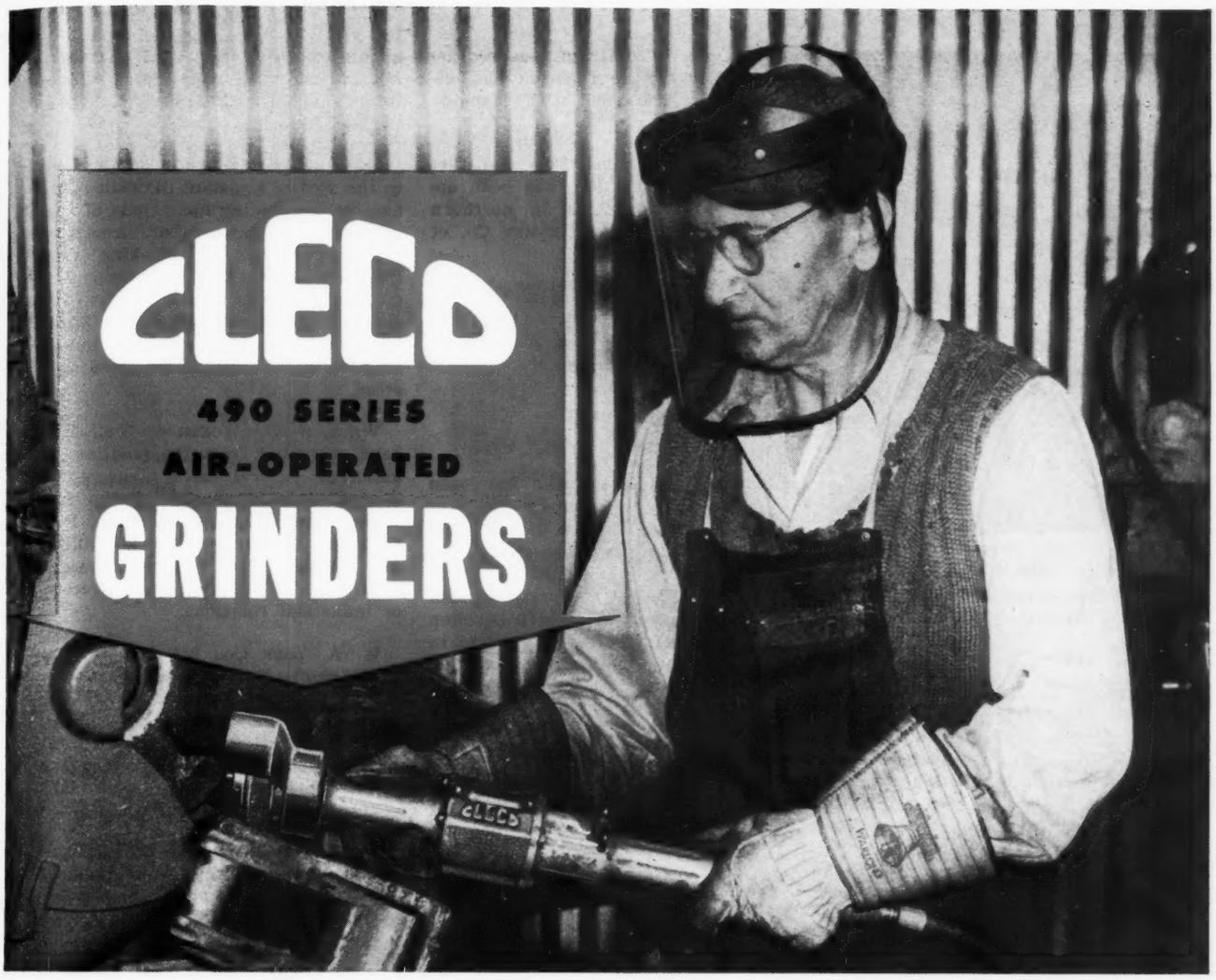
DOEHLER-JARVIS CORPORATION, New York City, is moving the executive office to the corporation's plant in Toledo, Ohio. H. H. DOEHLER, honorary chairman of the board, will retain his headquarters in New York City.

WILLIAM H. GIBBONS, assistant advertising manager of Tinnerman Products, Inc., Cleveland, Ohio, has been promoted to the position of advertising manager.

WELLMAN BRONZE & ALUMINUM Co., Cleveland, Ohio, has opened a new office at 12800 Shaker Blvd., Cleveland 20, Ohio, for its executive and sales departments.

HAROLD L. HERNDON was recently appointed district manager in charge of the Cleveland district of the Raytheon Mfg. Co., Waltham, Mass., with offices at 902 Hanna Bldg., Cleveland, Ohio.

L. H. WOODS is joining the Cleveland Tapping Machine Co., Canton, Ohio, a subsidiary of Automatic Steel Products, Inc., in a sales capacity.



Fast grinder for Mn.-Mo. steel castings

Cleco 490 Series Grinders do a fast, economical job of cleaning up hard castings like these of manganese-molybdenum alloy steel. They cut fast—reducing cleanup time—and they stay on the job with a minimum of maintenance.

Don't waste time and money trying to use the wrong grinder when you can cut costs and increase output just by selecting the right tool.

Go over your grinding problems with a Cleco Field Engineer. Let him help you select the right grinder for each application. Ask him to suggest ways to get the most out of each tool. You will be surprised at the savings you can make.

CLECO AIR TOOLS

PNEUMATIC DALEY EQUIPMENT ACCESSORIES

CLECO DIVISION

of the REED ROLLER BIT COMPANY, 5125 Clinton Drive, Houston 20, Texas, U.S.A.

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GEORGIA: Atlanta 3, 502 Peters Bldg. • ILLINOIS: Chicago, 5701 West Madison St. • MASSACHUSETTS: Worcester, 23 Enfield St.
MICHIGAN: Detroit, 2832 East Grand Blvd. • MISSOURI: St. Louis 3, 2322 Locust St. • NEW JERSEY: Newark 4, 75 Lock St.
OHIO: Cincinnati 2, 729 Temple Bar Bldg. • PENNSYLVANIA: Philadelphia 20, 5220 North Fifth St. . . . Pittsburgh 17, 5626 Phillips Ave.
TEXAS: Fort Worth, 1717 East Presidio • CALIFORNIA: Los Angeles, 1317 Esperanza St. • MARYLAND: Baltimore 20, 39D Oak Grove Dr.

In Canada: Cleco Pneumatic Tool Company of Canada, Ltd., 927 Millwood Road, Toronto (Leaside), Ontario
DISTRIBUTORS IN PRINCIPAL CITIES OF THE UNITED STATES AND THOUGHOUT THE WORLD

3322

Clifford R. Meyer, new vice-president and secretary of the Morris Machine Tool Co.

CLIFFORD R. MEYER has been appointed vice-president and secretary of the Morris Machine Tool Co., Cincinnati, Ohio, manufacturer of radial drills and high production machine tools. Mr. Meyer has been associated with the company for the last four years as secretary.

W. E. TODD has been appointed eastern manager for the Pre-Engineered Division of Mechanical Handling Systems, Inc., Detroit, Mich. His office is in the Sheraton Alms Hotel Bldg. in Cincinnati, Ohio.

ROBERT W. ELLMS has been promoted to the position of assistant chief engineer in the Machine Division of the Osborn Mfg. Co., Cleveland, Ohio. TED HATCH has become supervisor of the research and development department of the Machine Division.

TOOL SUPPLY CO., 2336 Prospect Ave., Cleveland, Ohio, has been appointed representative in northern Ohio for the KELLY REAMER CO. of Cleveland, Ohio.

J. N. FAUVER CO., INC., Detroit, Mich., has opened a branch at 1534 Keystone Ave., Dayton, Ohio. KEN MILLER will be in charge of this office.

Pennsylvania

WALTER A. RENTSCHLER has been appointed vice-president in charge of the Eddystone Division of the Baldwin-Lima-Hamilton Corporation, Philadelphia, Pa. Mr. Rentschler, who was previously vice-president in charge of the Lima-Hamilton Division of the Corporation, will continue in charge of the Hamilton plant. J. F. CONNAUGHTON has been appointed general manager of that plant. Mr. Rentschler was appointed to fill the vacancy created by the resignation of J. R. WEAVER, vice-president of the defense and special products division. Mr. Weaver has joined the Westinghouse Electric Corporation.

FRANK INGHAM was recently appointed manager of the Cleveland office of the Atlas Chain & Mfg. Co., Philadelphia, Pa.

ROBERT J. MACMEEKIN has been made chief engineer of the Pump Division of the C. H. Wheeler Mfg. Co., Philadelphia, Pa., manufacturer of condensers, pumps, and marine equipment. H. O. FULLAM has been appointed chief industrial engineer. Mr. Fullam was formerly shop superintendent of the G. A. Gray Co., Cincinnati, Ohio.

HAROLD C. ERSKINE has been named to the post of assistant division manager of die casting operations of the Aluminum Company of America, Pittsburgh, Pa. Mr. Erskine was formerly manager of the company's Cleveland works; H. J. MORRISON, assistant works manager at the Cleveland works, has been promoted to the position of manager, in Mr. Erskine's stead.

WILLIAM H. WORRILOW, JR., has been promoted from the position of assistant general sales manager to general sales manager of the Lebanon Steel Foundry, Lebanon, Pa., producer of carbon, special alloy, and stainless steel castings. ROBERT C. MCCONNELL has been made director of industrial relations.

W. A. YORK CO., 945 S. 53rd St., Philadelphia, Pa., has been appointed sales representative for the CLEVELAND TRAMRAIL DIVISION OF THE CLEVELAND CRANE & ENGINEERING CO., Wickliffe, Ohio. W. A. YORK, who, up to this time, has been assistant chief engineer of the Division, will be in charge of the office.

GORDON KIMBALL has been appointed representative and tool engineer for Kennametal, Inc., Latrobe, Pa., in the New England area. His headquarters will be 1537 Main St., Springfield, Mass. THOMAS FRY has been made application engineer in the Middle Atlantic district.

JULES K. EGERMAN has been made district manager of sales of the Columbia Steel & Shafting Co., and Summerill Tubing Co. Division, with headquarters in Philadelphia. Offices of both companies are in the City Line Center Bldg., Philadelphia, Pa.

OTTO G. SCHWENK has been named vice-president in charge of industrial products for the Blaw-Knox Co., Pittsburgh, Pa. Mr. Schwenk was formerly vice-president in charge of production for the Yale & Towne Mfg. Co., New York City.

O. D. RICE, chief engineer of the Rust Furnace Co., Pittsburgh, Pa., has been appointed to the newly created post of manager of operations for the company. H. HAYWARD DINNEEN has been made chief engineer to fill the vacancy.

W. J. LANGACHER has been appointed chief engineer of the Aetna-Standard Engineering Co., Pittsburgh, Pa., while G E. MANDRY has been made assistant chief engineer of the Pipe and Tube Division.

(Continued on page 245)

(Left) Robert W. Ellms, assistant chief engineer, Machine Division of the Osborn Mfg. Co.; (Right) Ted Hatch, supervisor, research and development department, also of the Machine Division

George A. Gade, head of the national sales organization of the Standard Pressed Steel Co.

GEORGE A. GADE, manager of outside sales for the Standard Pressed Steel Co., has transferred his headquarters from Detroit, Mich., to the plant in Jenkintown, Pa., where he will be in charge of the company's nation-wide sales organization.

MILLARD F. CORNWELL has been appointed Philadelphia sales representative for the American-Fort Pitt Spring Division, H. K. Porter Co., Inc., Pittsburgh, Pa.

RAYMOND J. ZALE has been appointed sales metallurgist for the Firth Sterling Steel & Carbide Corporation, Pittsburgh, Pa.

LLOYD R. COOPER, director of research for the Heppenstall Co., Pittsburgh, Pa., has been appointed chief metallurgist of the company's plant at Eddystone, Pa.

Wisconsin and Iowa

ROY E. MCCULLOUGH has been made resident plant manager in charge of manufacturing at the AC Spark Plug Division, Milwaukee, Wis., of General Motors Corporation. He succeeds PAUL W. RHAME who has become general manager of the Rochester Products Division of the corporation at Rochester, N. Y. During World War II, Mr. McCullough played an important part in the production of AC war products, which included 0.50 caliber Browning machine guns, automatic pilots, bombsights, and precision aviation instruments.

C. O. WANVIG, JR., secretary of the Peerless Machine Co., Racine, Wis., was recently elected president of the company, succeeding the late J. R. MCDONALD. Other company officials elected were: Frank T. Frey, vice-president; O. M. Jensen, vice-president in charge of engineering; and Frank T. Wruk, vice-president in charge of sales.

ORRIN W. BARKER has been promoted from the position of assistant chief engineer to chief engineer of

Orrin W. Barker, newly appointed chief engineer of the Kearney & Trecker Corporation

the Kearney & Trecker Corporation, Milwaukee, Wis. Mr. Barker has been associated with the company continuously since 1925.

MARVIN L. NELSON has been appointed works manager of the Wakonda Works, Des Moines, Iowa, by the Solar Aircraft Co., San Diego, Calif.

* * *

Vacuum Impregnation Prevents Castings from Leaking

Vacuum impregnation with sodium silicate or other heat-resistant materials can be used to prevent metal castings from leaking under pressure. This treatment is particularly suitable for brass, bronze, aluminum, magnesium, and other light metals—and even for iron and steel. It has no effect on the machining or metallurgical characteristics of the metal. Although not recommended for visible porosities, which permit spurting under hydraulic pressure, vacuum impregnation is a valuable means of preventing "leakers" or "weepers" in castings. The F. J. Stokes Machine Co., Philadelphia, Pa., a manufacturer of high-vacuum equipment, has been active in the development of impregnation processes.

Coming Events

APRIL 1-4—Twenty-first annual conference on packaging, packing, and shipping and NATIONAL PACKAGING EXPOSITION at the Public Auditorium in Atlantic City, N. J. Further information can be obtained from the American Management Association, 330 W. 42nd St., New York City.

APRIL 7-9—Annual meeting of the AMERICAN SOCIETY OF LUBRICATION ENGINEERS at the Statler Hotel, Cleveland, Ohio. National secretary, W. F. Leonard, 343 S. Dearborn St., Chicago 4, Ill.

APRIL 7-9 — Spring Manufacturing Conference of the AMERICAN MANAGEMENT ASSOCIATION, at the Hotel Statler, New York City. Public relations director, Donald G. Keen, 330 W. 42nd St., New York City.

APRIL 17-18—Spring meeting of the AMERICAN MACHINE TOOL DISTRIBUTORS' ASSOCIATION at the Edgewater Beach Hotel in Chicago, Ill. Executive secretary, Thomas A. Fernley, Jr., 1900 Arch St., Philadelphia 3, Pa.

APRIL 24-25—Seventh Annual Time Study and Methods Conference sponsored by the SOCIETY FOR ADVANCEMENT OF MANAGEMENT and AMERICAN SOCIETY OF MECHANICAL ENGINEERS, at the Hotel Statler, New York City. For further information write to the Society for Advancement of Management, 411 Fifth Ave., New York 16, N. Y.

APRIL 29-30—Eighth annual meeting of the METAL POWDER ASSOCIATION and METAL POWDER SHOW at the Drake Hotel, Chicago, Ill. Headquarters of the Association, 420 Lexington Ave., New York 17, N. Y.

MAY 1-7 — International Foundry Congress and Show at Convention Hall, Atlantic City, N. J. Sponsored by the AMERICAN FOUNDRYMEN'S SOCIETY, 616 S. Michigan Ave., Chicago 5, Ill.

MAY 5-16—BRITISH INDUSTRIES FAIR at London and Birmingham, England. For further information, write to British Information Services, 30 Rockefeller Plaza, New York 20.

MAY 8-9 — Methods and Measurement Clinic and National Convention of the AMERICAN INSTITUTE OF INDUSTRIAL ENGINEERS, sponsored by the Dayton Chapter of the Institute, in Dayton, Ohio. Further information can be obtained from R. E. Allen, Univis Lens Co., 401 Leo St., Dayton 1, Ohio.

MAY 14-16—National spring meeting of the SOCIETY FOR EXPERIMENTAL

STRESS ANALYSIS at the Lincoln Hotel, Indianapolis, Ind. Further information can be obtained from V. H. McNeilly, Purdue University, Lafayette, Ind.

MAY 22-24 — Sixth annual convention of the AMERICAN SOCIETY FOR QUALITY CONTROL at the Onondaga County War Memorial, Syracuse, N. Y. Further information can be obtained by addressing the Society at Room 5036, 70 E. 45th St., New York 17, N. Y.

JUNE 2-4—Annual meeting of the AMERICAN GEAR MANUFACTURERS ASSOCIATION at the Homestead, Hot Springs, Va. Executive secretary, John C. Sears, Empire Bldg., Pittsburgh 22, Pa.

JUNE 9-21 — Triennial meeting of the INTERNATIONAL ORGANIZATION FOR STANDARDIZATION at Columbia University, New York City. June 11-14, meeting of the Screw Threads Committee of the I.O.S. For further information, write to the American Standards Association, 70 E. 45th St., New York 17, N. Y.

JUNE 23-27 — Fifieth anniversary meeting of the AMERICAN SOCIETY FOR TESTING MATERIALS at the Hotels Statler and New Yorker in New York City. Further information can be obtained from the executive secretary, C. L. Warwick, 1916 Race St., Philadelphia 3, Pa.

SEPTEMBER 8-10 — THIRD NATIONAL STANDARDIZATION CONFERENCE sponsored by the American Standards Association in Chicago, Ill. Headquarters, Museum of Science and Industry. Further information can be obtained from the Association, 70 E. 45th St., New York 17, N. Y.

NOVEMBER 19—Thirty-fourth annual meeting of the AMERICAN STANDARDS ASSOCIATION at the Waldorf-Astoria in New York. Headquarters of Association, 70 E. 45th St., New York City.

* * *

Summer Management Course at Iowa State University

The College of Engineering, State University of Iowa, announces the thirteenth summer management course to be held June 9 through June 21. The subjects to be covered will include production planning: job evaluation; motion and time study; wage incentives; plant layout; quality control; supervisory training; labor relations and legislation; organization and policy; and public speaking. Further information can be obtained from Wayne Deegan, 113 Engineering Bldg., State University of Iowa, Iowa City, Iowa.

Obituaries

Phil Huber

Phil Huber, chairman of the board of directors of the Ex-Cell-O Corporation, Detroit, Mich., died at his home on February 7, after a brief illness, at the age of sixty-two years. Mr. Huber was educated in Cincinnati, Ohio, and served his apprenticeship there as a toolmaker with Smith & Mills. Following this, he went to Indianapolis where he became associated with the automobile industry. Shortly after World War I, a small group of fellow workers in one of the major automobile companies in Detroit, organized a new company to serve Ameri-

Phil Huber

can industry in the field of precision machining. Mr. Huber was a member of this group, which incorporated, on July 9, 1919, the Ex-Cell-O Tool & Mfg. Co., predecessor of the Ex-Cell-O Corporation. He was elected a director and first secretary.

As the concern expanded in the manufacture of precision machine tools, cutting tools, etc., Mr. Huber held successively the positions of chief inspector, superintendent, factory manager, and vice-president. In 1937, he was made president and general manager, the position he held until he became chairman of the board of directors in 1951.

Heyman Rosenberg

Heyman Rosenberg, founder of the Parker-Kalon Corporation, New York City, died on February 29 in New York at the age of seventy-eight years. Mr. Rosenberg was a director and officer in the company which he established with Louis Goldburg in

Heyman Rosenberg

1914. He came to this country in his youth and entered the business of sheet metal fabrication, which led to his interest in fasteners. He was a prolific inventor, having been granted over 200 U. S. and foreign patents, most of which covered screws of various types and machinery for their production. Mr. Rosenberg was the originator and patentee of self-tapping screws, which are today universally used in the assembly of automobiles, aircraft, ships, and products of every description.

Mr. Rosenberg was the recipient of many engineering honors, including an award by the Franklin Institute of Philadelphia and a pioneer inventor's award by the National Association of Manufacturers. He is survived by his wife and four daughters.

ROLAND R. PRESTON, die sales engineer in the Pittsburgh office of the Carboloy Department of General Electric Co., died on March 5 at his home in Pittsburgh, Pa., after a short illness at the age of sixty-four years. Mr. Preston was born in Ferrisburg, Vt. In 1908, he become associated with the Page Steel & Wire Co., Monessen, Pa., where he eventually became superintendent of the wire mill. He resigned this position in 1941 to become die sales engineer in the Pittsburgh office of the Carboloy Co. Mr. Preston was a specialist in the drawing of high carbon wires and was well known in the wire industry. He is survived by his wife.

* * *

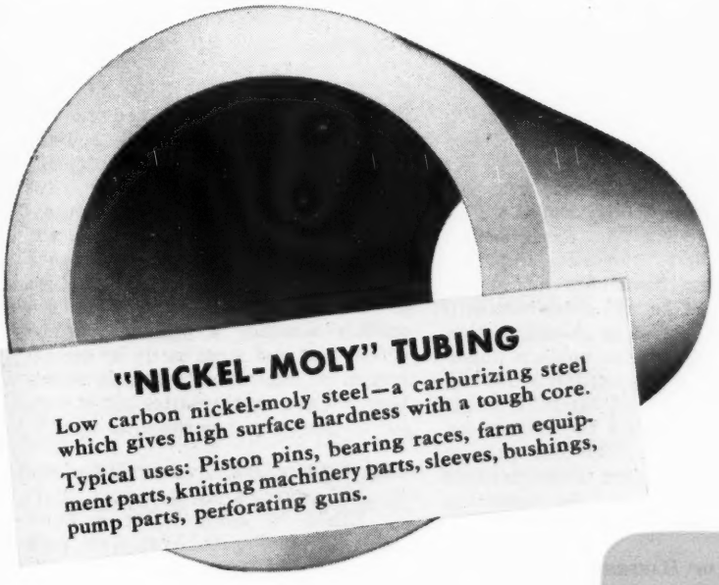
The United States does not now produce enough copper, lead, or zinc to meet its needs. It imports 31 per cent of its copper, 44 per cent of its lead, and 41 per cent of its zinc.

Pinched for steel?

These 2 TIMKEN® wear-resistant steels will do 90% of your hollow parts jobs!

52100 TUBING

High carbon chrome steel—a direct-quenching steel which gives through hardness in moderate sections. Typical uses: aircraft parts, slitter knives, bearing races, collets, bushings, spindles, grinding machine parts, precision instrument parts, pump parts and plungers.



"NICKEL-MOLY" TUBING

Low carbon nickel-moly steel—a carburizing steel which gives high surface hardness with a tough core. Typical uses: Piston pins, bearing races, farm equipment parts, knitting machinery parts, sleeves, bushings, pump parts, perforating guns.

. . . and are available now in small lots

If you're in a big hurry for a small amount of steel tubing, let Timken 52100 and Timken "Nickel-Moly" steels help you out. These two general purpose steels have good hardenability and wear resistance, can do 9 out of 10 of your hollow parts jobs! And they're available for immediate shipment in small quantities within 24 hours after receipt of your order!

Use Timken 52100 steel if you need a steel that can be heat treated to file hardness and tempered back to any desired point. A high carbon steel, it is through-hardening in moderate sections, has high wear resistance and can often be used in place of more expensive steels. Available in 101 sizes from 1″ to 10½″ O.D.

Use "Nickel-Moly" if you want a steel with exceptional stamina and shock absorbing qualities. It is a low carbon, carburizing steel that develops high case hardness and a tough core. Available in 52 sizes from 1⅜″ to 10¼″ O.D.

With both these Timken steels, you can be sure of uniformity from tube to tube and order to order. That's because the Timken Company maintains rigid quality control from melt shop through final tube inspection. For the current mill stock list, write The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

TIMKEN

TRADE-MARK REG. U.S. PAT. OFF.

Fine Alloy

STEEL

and Seamless Tubes

Specialists in alloy steel—including hot rolled and cold finished alloy steel bars—a complete range of stainless, graphitic and standard tool analyses—and alloy and stainless seamless steel tubing.

New Books and Publications

EXTRUSION OF PLASTICS, RUBBER, AND METALS. By Herbert R. Simonds, Archie J. Weith, and William Schack. 454 pages, 6 by 9 inches. Published by the Reinhold Publishing Corporation, 330 W. 42nd St., New York 18, N. Y. Price, $10.

All branches of the extrusion industry—die design, equipment engineering, process control, materials used, cost computation—are covered in this comprehensive book on the extrusion of plastics, rubber, and metals. Two-thirds of the material is devoted exclusively to the extrusion of plastics, the extruding machine as an industrial unit being fully described and the many applications of extruded plastics being discussed. Commercially important methods of dry extrusion, such as use of multiple-screw machines; multi-color extrusion; production of sheets and films; and compressing, pelletizing, and extrusion packaging are described in a detailed manner. The remainder of the book focusses attention on the extrusion of metals (sheet, rods, billet, etc.) and other materials.

An advisory committee of ten men associated with the extrusion industry assisted the authors in making the book practical and authoritative. A twenty-one-page glossary aids the reader not completely familiar with the technology; also included are lists of manufacturers of extruded products and extrusion equipment, as well as technical and conversion tables.

FORGING AND FORMING METALS. By S. E. Rusinoff. 279 pages, 5 1/2 by 8 1/2 inches; over 200 illustrations. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago 37, Ill. Price, $3.95.

The forging process has undergone vast technological changes throughout the years. Forging in modern production is not a rigid process using the same technique in all industrial applications; it is composed of several methods, the choice of which depends not only upon the specific product wanted — its type, size, shape, and physical requirements—but also upon the judgment and experience of the designer and production engineer. The author of this book has endeavored to present the "know how" and "know why" of these improved forging methods.

Impact forging, press forging, upset forging, extrusion, heat-treatment of forgings, cleaning and finishing of forgings, inspection, safety, metal quality, and the design of forged parts, as well as tools and dies, are all thoroughly covered. Each subject is treated as a separate unit to facilitate reference. In many cases, the entire sequence of a forging process is illustrated—from the first operation on metal stock to the finished forging. A chapter entitled "Standard Practices and Tolerances for Impression Die Forgings," a glossary of forging terms, and an appendix of useful tables are included.

FINISHING MATERIALS AND METHODS. By George A. Soderberg. 320 pages, 6 by 9 inches; 189 charts and illustrations. Published by the McKnight & McKnight Publishing Co., Market and Center Sts., Bloomington, Ill. Price, $4.

Great improvements and changes in both the materials used in protective coatings on wood and metal and in the methods of applying them have occurred in the last few years with the development of plastics and luminescent paints and the use of synthetics. This book has been written primarily as a text for use in the teaching of finishing and of painting and decorating in the vocational and industrial education classes at the high school, college, and vocational level. However, it will also be of value to anyone, whether a novice or craftsman, who is interested in modern finishing.

The book is divided into two sections: Finishing Materials and Finishing Methods. The first section covers not only the new finishing materials that have been introduced on the market, but the older ones still in extensive use. The second section is concerned with the modern finishing methods — brushing, spraying, dipping, rolling, and tumbling—that have been devised for the application of new materials. The last part of this section is devoted to the methods of procedure involved in producing specific finishes.

ELEMENTS OF HARDENABILITY. By M. A. Grossmann. 164 pages, 6 by 9 inches. Published by the American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio. Price, $4.50.

This discussion of the hardenability of steel covers four aspects of the subject—hardenability tests, the nature of hardening, the nature of the quenching process, and the effects of alloying elements on hardenability. The first chapter is devoted to a history of the various methods developed to measure and designate hardenability precisely, and a discussion of the characteristics of steel that affect its hardenability. The second chapter describes changes that take place in the structure of steel as the result of hardening. It presents a resume of the isothermal transformation diagram. The third chapter deals with the actual rates of cooling at various positions in bars being quenched when different sizes and shapes are quenched, and when the quenching medium is changed, with resultant variation in quenching severity. The last chapter describes a method of calculating hardenability from chemical composition and grain size.

MATHEMATICAL ENGINEERING ANALYSIS. By Rufus Oldenburger. 426 pages, 6 by 9 inches. Published by the Macmillan Co., 60 Fifth Ave., New York 11, N. Y. Price, $6.

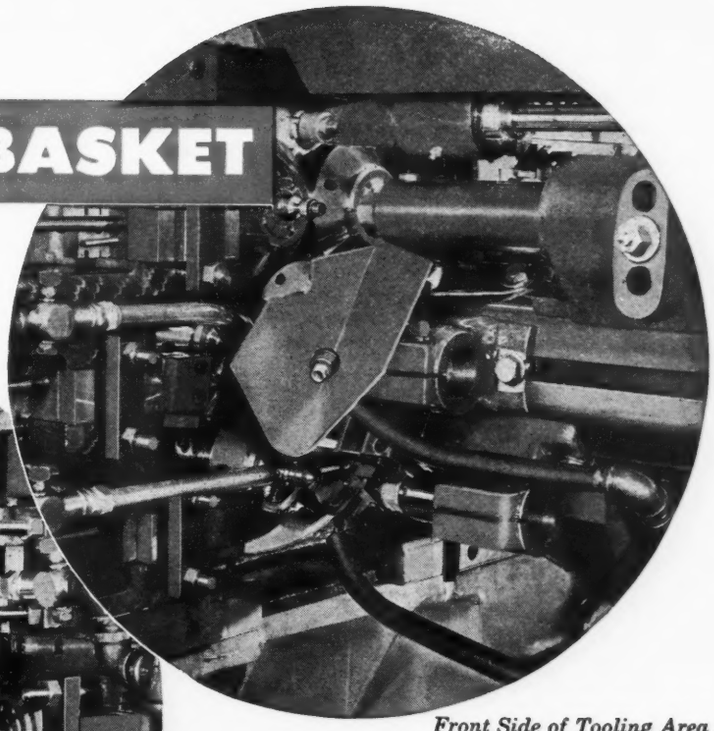
The purpose of this book is to present a guide to the mathematical solution of engineering problems. The author shows clearly how to analyze a wide variety of engineering problems and how to set up equations for solving them. This is done for the entire field of technical physics, including mechanics, heat, and electricity. Thus the book fills the need for a self-contained work on applied mathematics covering the entire engineering field. Nearly 200 problems are included in the book, together with their mathematical solutions.

The material is divided into five principal sections, classified as follows: Mechanics of rigid bodies; electricity and magnetism; heat; elasticity; and fluid mechanics. Engineers engaged in research, development, or engineering analysis will find the principles and techniques here presented of value. By the use of this book, it is possible to see quickly whether a problem can be solved best and most easily by mathematics or experiment. It also shows how to use mathematics effectively for interpreting experimental results.

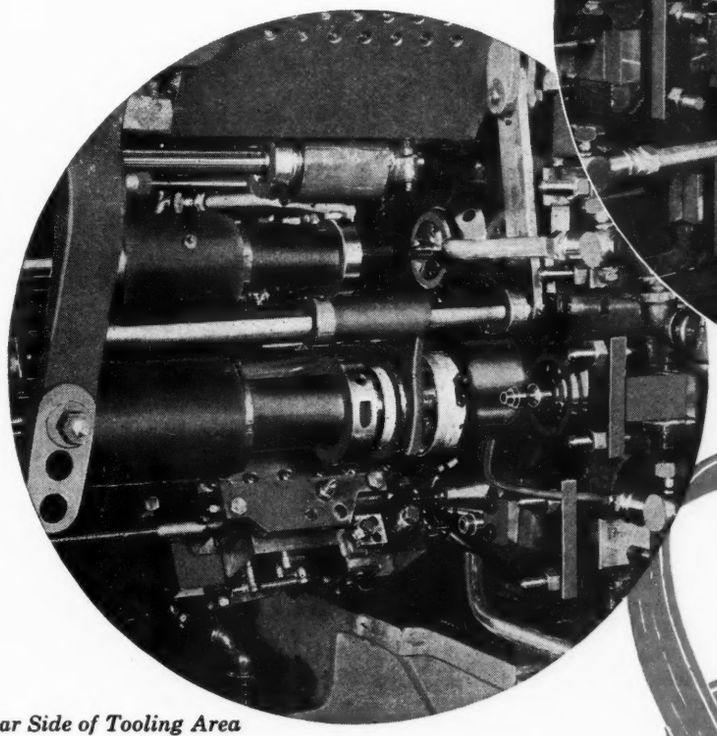
PLASTICS MOLDING. By John Delmonte. 493 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price, $9.

The successful conversion of organic plastics materials into industrial products depends to a great extent upon adequate molding processes and equipment. Because the characteristics of organic plastics undergo marked changes during molding, considerable skill in applying equipment and a clear understanding of the chemical and physical changes that occur in these materials must be acquired by the molder. This new book on plastics molding presents a carefully planned analysis of the industry and the equipment used, as well as the principles and accessories that permit a molder to attain a high degree of versatility.

MORE IN ONE BASKET



Front Side of Tooling Area



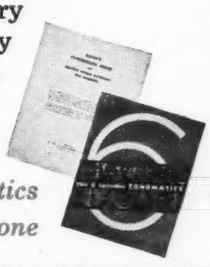
Rear Side of Tooling Area

The "automatic" has substantiated many of the advantages of centralized responsibility in metal turning.

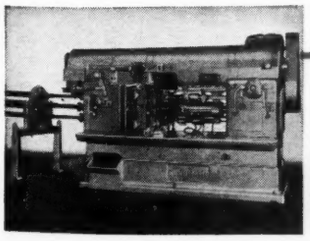
Even the earlier users realized that more work pieces can be profitably placed in one basket *if nothing upsets the basket.* Dependable performance has always been vital to the successful use of the "automatic".

The factors that determine the degree of dependability of an "automatic" are a very important part of its specifications. They are a part of the *complete* information available on CONOMATICS.

In producing the above part on a 1⅝"-SIX, the cycle time of 14 seconds per piece is not as important as the total time necessary for the entire run. Dependable performance pays.



A Comparison of ALL Automatics is in Favor of Cone



Conomatic CONE AUTOMATIC MACHINE COMPANY, INC. WINDSOR, VT., U.S.A.

The book considers first the flow of materials, and second, the techniques for handling the materials after the flow has been properly established. It discusses the selection of equipment and its adaptation to molding problems as well as the design and construction of molds. Among the subjects covered are compression and transfer molding; injection molding; extrusion; finishing; heat and pressure generation; distribution of gases and fluids; instrumentation for the molding plant; and plant lay-out.

MANUFACTURING PROCESSES. By Myron L. Begeman. 608 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price, $6.

This is the third edition of a book designed to help the reader select the processes and machines best suited for the manufacture of a particular product. It covers all the important manufacturing processes and machines now available, discusses their advantages and drawbacks, and describes the tools required for each machine.

The first half of the book is devoted to foundry practice, pattern work, plastic molding, powder metallurgy, hot- and cold-working of metals, heat-treatment, and welding. The second half covers measuring instruments, cutting tools, and machines and accessories. The book has been revised to include recently developed machines and processes and contains new material on such developments as the continuous casting of metal, Marforming, stud welding, multi-station transfer machines, and many other automatic production machines.

BASIC BLUEPRINT READING AND SKETCHING. By C. Thomas Olivo and Albert V. Payne. 145 pages, 8 by 10 inches. Published by Delmar Publishers, Inc., 650 Broadway, Albany 1, N. Y. Price, plastic-bound, $2.25; cloth-bound, $3.40.

The objective of this book is to provide instruction material for those who must develop the ability to read and interpret blueprints and make shop sketches without the use of drawing instruments. The text is divided into two parts, the first of which deals with lines, views, dimensions and notes, and sections. Part 2 covers the principles and applications of shop sketching.

Each instructional unit contains an outline of specific objectives; an explanation of the principle under discussion; application of the principle in an actual blueprint; and an assignment problem to test the student for mastery. The book contains over 40 industrial blueprints and sketches.

BAND TOOL MANUAL. 160 pages, 6 by 9 inches. Published by the DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill. Price, $2.

The purpose of this manual is to present simplified methods for selecting and operating band tools and machines for sawing, slicing, grinding, filing, and polishing all materials. The manual is composed of six chapters dealing with the following subjects: Research Service for Band Tools; Band Tool Terminology; Do-All Band Tool Types; Band Tool Performance; Setting up the Band Tool; and Band Tool Selection Charts. The eighty-two band tool selection charts presented in the last chapter are alphabetically arranged according to kind of material, and give recommended band machining factors for obtaining optimum cutting rate, tool life, and finish on different thicknesses of material. These factors include type of band tool to be used, speed, pitch, feed, coolant, etc.

MILLING CUTTER PRODUCTION AND CALCULATION. 54 pages, 5 1/2 by 8 1/2 inches. Published by the Machinery Publishing Company, Ltd., National House, West St., Brighton 1, England. Sold in the United States by THE INDUSTRIAL PRESS, 148 Lafayette St., New York 13, N. Y. Price, 75 cents.

This book—No. 29 of MACHINERY'S Yellow Back Series—discusses the design and manufacture of milling cutters, and provides the necessary calculations and formulas for correct set-up for milling the flutes. An idea of the treatment will be obtained from the following chapter headings: Milling Front and Face Teeth on Helically Fluted Cutters; Accurate Production of Spiral Mills; Calculations for the Manufacture of Milling Cutters; Tables and Graphs for Milling Cutter Calculations; and Calculation of Offsets for Milling Spiral Cutters.

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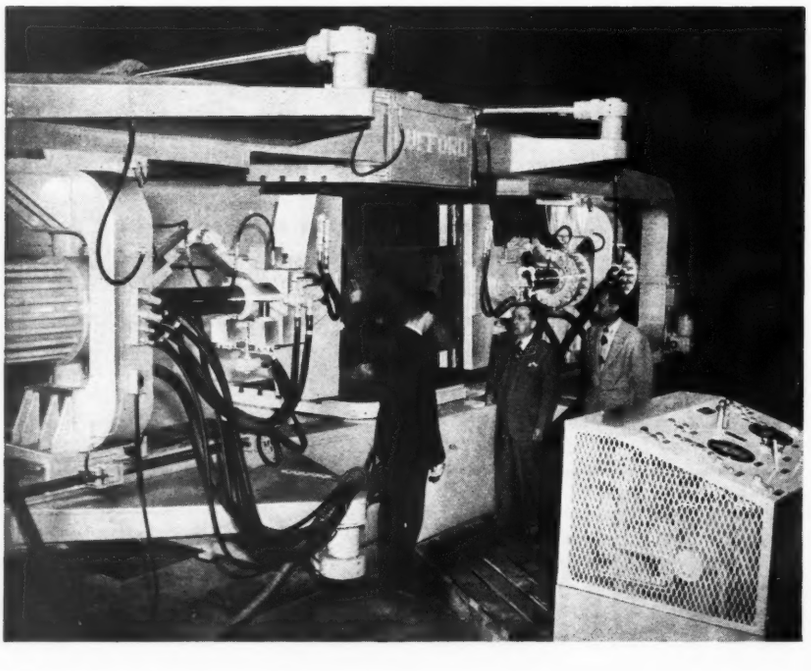
The Mathewson Gold Medal was recently awarded to three employes of the General Electric Co. for outstanding achievement in the field of metallurgy. Recipients of the award were Cecil G. Dunn, Franklin W. Daniels, and Michael J. Bolton, of the company's laboratory engineering department, Pittsfield, Mass.



Sheets measuring 48 by 144 inches can be stretch-formed on this stretch-wrap type forming machine recently delivered to the Sikorsky Division of United Aircraft Co., Bridgeport, Conn., by the Hufford Machine Works, Inc., El Segundo, Calif. This new Model 92 machine will be used for making nose parts, clamshell doors, and body coverings for the Sikorsky Model S-55 helicopters, and will help relieve present stretch-wrap forming equipment now being used twenty-four hours a day. H. P. Smith (left), sales manager of Hufford Machine Works, is seen demonstrating the machine at the El Segundo plant to J. T. Galligan (center), Sikorsky's chief tool engineer, and Henry Nemzura (right), western representative for Sikorsky.